guide to CROP PROTECTION in Alberta 1986

PART 1
CHEMICAL

Herbicides Fungicides Insecticides

Alberta
AGRICULTURE
AGDEX 606-1

86-03436/

POISON CONTROL CENTRES

UNIVERSITY OF ALBERTA
83 Avenue - 112 Street
Edmonton, Alberta
Phone: 432-8432

ROYAL ALEXANDRA HOSPITAL
10240 Kingsway Avenue
Edmonton, Alberta
Phone: 477-4444

CALGARY GENERAL HOSPITAL
841 Centre Avenue E.
Calgary, Alberta
Phone: 262-5982 OR 268-9625

FOOTHILLS HOSPITAL
1403 - 29 Street N.W.
Calgary, Alberta
Phone: 270-1315

The Telephone Number of the Emergency Department of the Hospital in

Your Area is (403)_____

Copies of this publication may be obtained from:

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Alberta Agriculture
7000 - 113 Street
Edmonton, Alberta, T6H 5T6
OR
Alberta Agriculture's district offices

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GUIDE TO CROP PROTECTION IN ALBERTA

1986

PART I – CHEMICAL

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ALL RECOMMENDATIONS IN THIS PUBLICATION ARE GIVEN IN QUANTITY OF COMMERCIAL PRODUCT PER ACRE (L OR KG/AC). PRODUCT LABELS ARE GIVEN IN QUANTITY OF PRODUCT PER HECTARE (L OR KG/HA). TO AVOID APPLICATION ERRORS BE SURE TO READ AND UNDERSTAND LABEL RECOMMENDATIONS.

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INSTRUCTIONS FOR USE OF GUIDE

This publication contains a set of foldout charts and descriptive text which must be used as a unit. When using, go through the following steps:

1. Identify the pests.
2. Refer to the appropriate foldout chart for the crop.
3. Record the pesticide(s) available from the chart.
4. Look up the pesticide(s) in the text and note characteristics, safety, method of application, effect on pest and crop, etc.
5. Select the product best suited to your need.
6. Apply according to instructions given on the label.

HERBICIDE PERFORMANCE RATINGS

Tolerance of Crop to Herbicides

The number appearing in brackets following the crop on which each herbicide is registered represents the expected tolerance of the crop to that herbicide. Due to variations in variety, weather, timing and application techniques this number is only approximate. 0 = complete kill of the crop and 9 = no measurable injury to the crop.

Level of Weed Control with each Herbicide

The number appearing in brackets after each weed represents the average level of weed control expected with the herbicide. Due to variation in weather, growth stage, time of day, application technique, etc. this number is only approximate. 0 = no control of the weed and 9.0 = complete kill of the weed.

PROPER MIXING OF PESTICIDES

1. Fill the sprayer half full with clean water.
2. Shake the closed pesticide container vigorously.
3. Slowly add pesticide to sprayer with agitator operating.
4. Allow container to drain into sprayer for 30 seconds.
5. Fill container one quarter full of rinse water.
6. Shake container vigorously, drain into sprayer for 30 seconds.
7. Repeat this procedure three times.
8. Fill sprayer tank with water, spray at once.
9. Always agitate vigorously if sprayer has been standing for a time after mixing.

ADDRESSES AND TELEPHONE NUMBERS – CHEMICAL COMPANIES

BASF Canada Inc.
10 Constellation Court
Rexdale, ON M9W 1K1
(416)675-3611

Chemagro Ltd.
2381 Ness Avenue
Winnipeg, MAN R3J 1A5
(204)885-1661

Chipman Inc.
P.O. Box 965
Winnipeg, MB R3C 2V5
(204)786-3421

Ciba Geigy Canada Ltd.
820 - 26 Street N.E.
Calgary, AB T2A 2M4
(403)273-5656

Cyanamid of Canada Ltd.
712H 6 Street S.E.
Calgary, AB T2H 2M8
(403)253-0924

Dow Chemical Canada Ltd.
2403 - 10104 103 Avenue
Edmonton, AB T5J 0H8
(403)428-0442
Toll Free: 1-800-661-6436

DuPont Canada Inc.
#105, 333 - 25 Street E.
Saskatoon, SK S7K 0L4
(306)244-4511

Elanco Products Division
Eli Lilly Canada Inc.
9635 - 45 Avenue
Edmonton, AB T6E 5Z8
(403)436-6131

Hoechst Canada Inc.
295 Henderson Drive
Regina, SK S4N 6C2
(306)924-1500

Interprovincial Co-op Ltd.
Box 1050
Saskatoon, SK S7K 3M9
(306)244-3208

Later Chemicals Ltd.
2239 - 14A Street S.E.
Calgary, AB T2G 3L1
(403)265-3501

May and Baker Canada Inc.
1865 Sargent Avenue, Bay #2
Winnipeg, MB R3H 0E4
(204)774-1819

Monsanto Canada Inc.
55 Murray Park Road
Winnipeg, MB R3J 3E2
(204)885-6740

MSD Ag Vet
Division of Merck Frosst Canada Ltd.
P.O. Box 1005, Pointe Clair
Dorval, PQ H9R 4P8

Pfizer Chemicals and Genetics Inc.
P.O. Box 2005
1 Wilton Grove Road
London, ON N6A 4C8
(519)681-2173

Rohm and Haas Canada Ltd.
Suite #17, 830 King Edward Street
Winnipeg, MB R3H 0P5
(204)774-1755

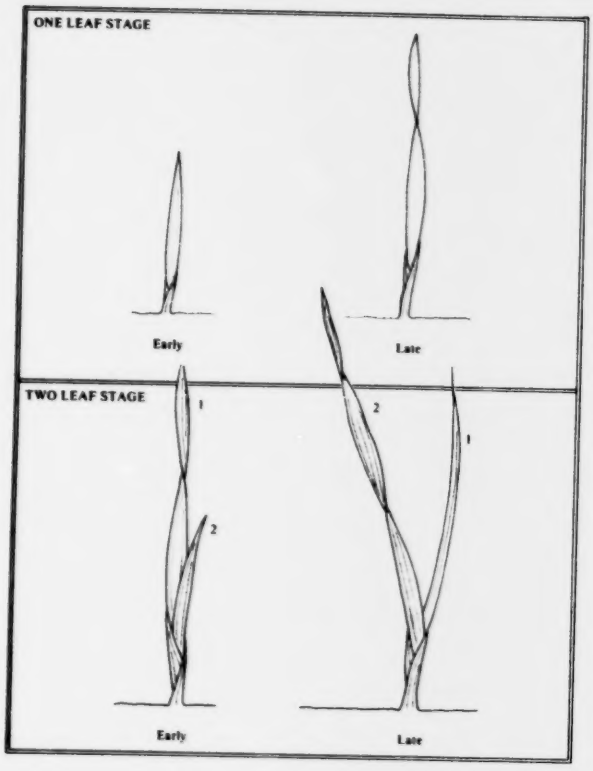
Sanex Inc.
9577 - 60 Avenue
Edmonton, AB T6E 0C1
(403)438-1928

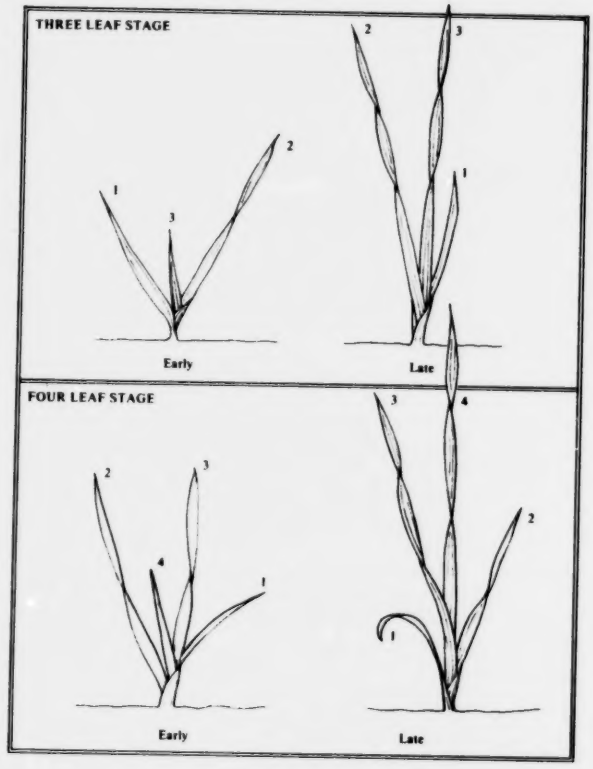
Union Carbide
5507 First Street S.E.
Calgary, AB T2H 1H9
(403)253-8471

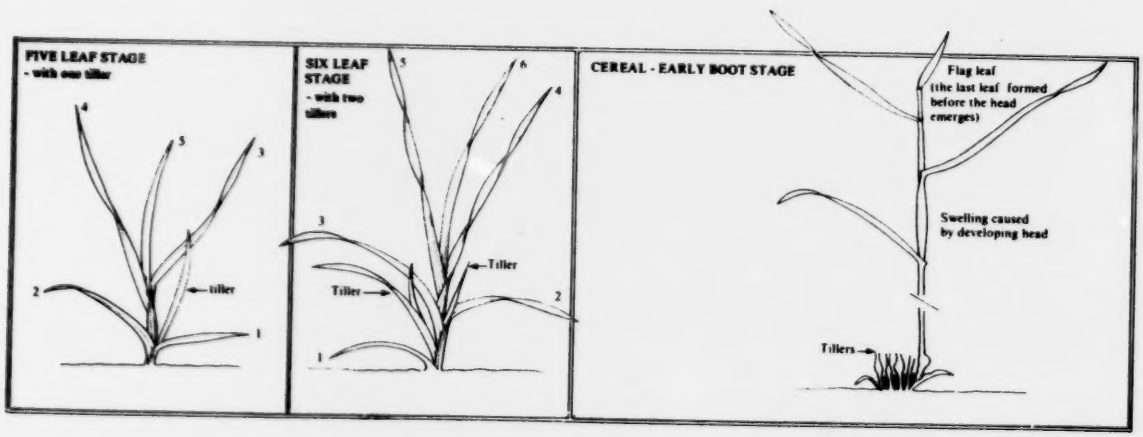
Uniroyal Chemicals
4, 1323 - 44 Avenue N.E.
Calgary, AB T2E 6L5
(403)276-9481

Velsicol Canada Inc.
Suite 302 Plaza 4
2000 Argentia Road
Mississauga, ON L5N 1W1
(416)821-7850

LEAF STAGES — CEREALS and GRASSES







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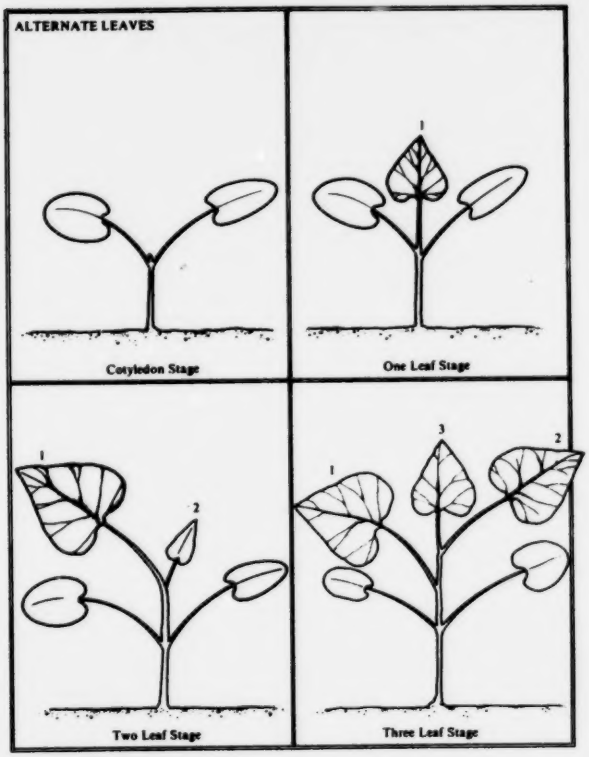

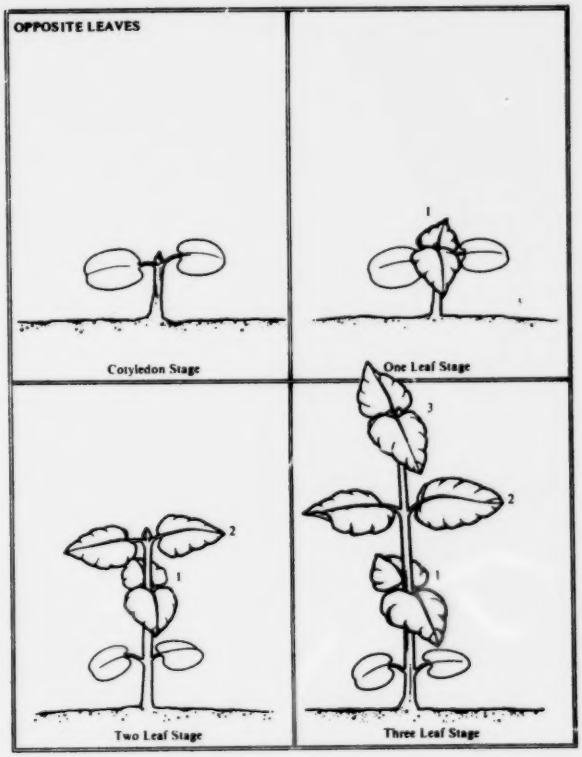

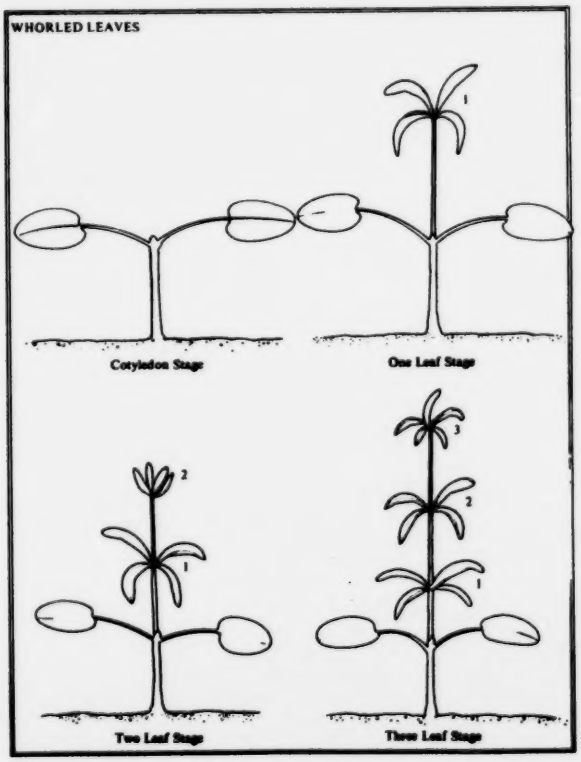

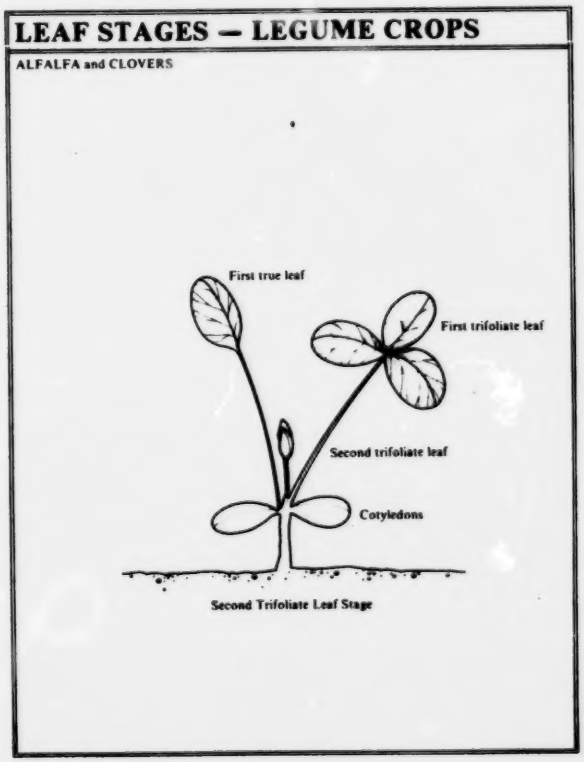

CHEMICAL PEST CONTROL IN ALBERTA

INTRODUCTION

This guide is to assist farmers to select and apply pesticides. Pesticides should be used in a management system including crops adapted to local climate and soil type. Use resistant varieties where available. Plant clean, disease free seed. A good seed bed and banded fertilizer give crops a head start on weeds. Use crop rotations, good sanitation and take care to prevent pests from overwintering. Destroy infestations at their source. Compared to the cost of pesticides these controls are cheap. Consider not only price and efficacy but also toxicity and persistence when choosing pesticides.

IDENTIFY THE PROBLEM EARLY

Often pest control occurs on an emergency basis but cheaper, more effective controls may be available if the problem is anticipated or detected early. Check fields often and anticipate problems, based on last year's situation.

AVOID UNSATISFACTORY RESULTS - (a) Crop damage or (b) Inadequate control. Years of testing precede a pesticide registration and result in explicit instructions on the label. Most failures happen when the farmer does not completely follow these directions.

COMMON REASONS FOR PESTICIDE FAILURE

1. Improper application
   - **Failure to apply the recommended amount.** Where rate ranges are given, the minimum is for light infestations using good sprayers and techniques. Growing conditions have to be good and crop competition normal. For less favourable conditions or high pest populations use the high rate. Heavy textured and high organic soils require higher rates of soil applied herbicides.
   - **Poor equipment.** Applications made with worn nozzles, loose hitches, low pressure or inadequate water volumes result in less control and possible crop damage.
   - **Failure to incorporate** soil-applied herbicides soon enough or thoroughly enough may result in loss of activity due to evaporation or ultraviolet breakdown. Follow label instructions carefully and ensure soil is properly prepared.
   - **Use of water** with suspended silt, a high pH or high mineral content may reduce effectiveness.
   - **Poor application technique** such as incorrect boom height, incorrect nozzles or pressure, plugged filters or excessive speed for the terrain all contribute to poor results.
2. Bad Timing
   Each pest has a most susceptible and each crop a most tolerant stage. A common problem is treating too late, after the pests develop resistance. A rule of thumb is treat early within the proper stage.
3. Selection of the wrong material
   Farmers rarely use a totally unsuitable pesticide but often several pesticides are available and they may not pick the best one available. Some of the weeds are controlled but better selection could control more species at no more cost. For best results examine the field and identify all of the weeds before making a selection.

WHAT TO DO IF RESULTS ARE UNSATISFACTORY

1. Compare your procedures, with the label instructions.
2. Check for plugged screens, nozzles worn or mixed by type or size.
3. Check calibration, work back from acres and amount of chemical.
4. Consider time since application. Some results are not apparent for several days. Look for early symptoms of the chemical taking effect.
5. If there are no results after a week seek technical help. Gather all relevant data, particularly evidence such as photos or dried specimens. Record wind, rainfall, soil moisture condition, crop variety, fertility and temperature at time of spraying, quantity of material used and acres treated.
6. Document everything in writing. If crop damage is involved submit a specimen for diagnosis. Disease or insect damage can resemble herbicide injury.

CHEMICAL MIXTURES

Many pesticides are tank mixed to extend the range of control or the timing. A mixture of two or more pesticides may prove synergistic. Some mixtures simply act as if the components were applied separately. In other mixtures the activity of one or both chemicals is reduced. Many mixtures have not been tested. For these reasons use only registered mixes.

ADJUVANTS (SURFACTANTS, WETTING AGENTS, SPREADERS, ETC.)

Adjuvants are compounds added to a pesticide to enhance application and/or performance. Pesticides are generally formulated

with the proper amount of adjuvant and additional quantities are not usually required. If adjuvants are considered, USE ONLY THOSE PRODUCTS NAMED AND RECOMMENDED ON THE LABEL. Failure to do so could result in: (a) Crop injury, (b) Reduced control, (c) Chemical residue in the crop, (d) Invalidation of pesticide warranty.

PESTICIDE SAFETY

1. LETHAL DOSE (LD_{50})

The LD_{50} of a pesticide is the single dose that kills 50% of a group of animals which are given the chemical by mouth (orally). It is measured as the amount, in milligrams, of chemical given per kilogram of body weight of the animal (mg/kg). THE LOWER THE LD_{50}, THE MORE DANGEROUS IS THE PESTICIDE.

The following table relates the oral LD_{50} (mg/kg) of a pesticide to its toxicity.

less than 50	500-1000	1000-2500	greater than 2500
high toxicity	moderate toxicity	low toxicity	very low toxicity
DANGER POISON	WARNING POISON	CAUTION POISON	

2. HUMAN EXPOSURE TO PESTICIDES

Farmers may be exposed to pesticides when they are (a) handling and mixing powders, dusts and granules; (b) opening containers of emulsifiable concentrates (E.C.); (c) pouring concentrated liquids into the sprayer tank; and (d) spraying.

Pesticides may enter the body through the skin (dermally) and mouth (orally), and by inhalation. Penetration through the skin is the most common way and occurs when the concentrated chemical is being handled, or the dilute material is being sprayed without proper safety clothing. Immediate illness may occur once enough chemical enters the body. Although many pesticides do not penetrate the skin, they may still cause skin problems such as redness, blisters, or dry scaliness that may lead to serious skin eczema and dermatitis. Pesticides may enter the body through cuts, scrapes and bruises which should be covered with band-aids or bandages. Eyes are very sensitive to pesticides. They can be exposed to vapour or fumes, spray drift, or accidental spills and splashes when containers of liquid concentrates are being opened or when the concentrated chemical is being poured into the sprayer tank.
Pesticides can enter through the mouth when a farmer eats or smokes with contaminated hands or when he licks his lips. Children may be poisoned if they drink pesticides stored in pop bottles. All pesticides should be stored in their original containers in a securely locked area out of reach of children.

Pesticides can also enter the body through the inhalation of fumes, dusts, or spray mists. In the case of fumes and extremely fine particles of dust or spray, complete absorption of chemical by the lungs can occur and the hazard is high.

3. STANDARD SAFETY PRECAUTIONS

Whenever working with pesticides, wear standard protective clothing: long sleeve shirt, full length pants, coveralls, rubber boots, and cap.

In addition to the standard clothing, use common sense to decide what extra protection is needed for a particular job. Sometimes the label on the pesticide container gives details of extra precautions required. Extra protective equipment is rubber or neoprene gloves, goggles, respirators, and gas masks.

a. *Coveralls:* Two types of coveralls are available: reusable and disposable. Reusable cotton coveralls are washable and can be used again and again. Disposable paper coveralls are usually more comfortable in hot weather and are lightweight. If they become damaged or severely contaminated, they should be discarded. Wash coveralls after every pesticide application or when contaminated.

b. *Rubber boots:* Do not wear leather boots and sneakers as they absorb pesticides and are difficult to clean. The legs from the coveralls should be outside the top of the boots to prevent spills and splashes from running into the boots. If the inside of the boots is contaminated, it should be washed out immediately.

c. *Caps:* Prevent powders, dusts, or spray mists being deposited on the hair or scalp and be absorbed into the body.

d. *Gloves:* These are required when handling, mixing, or pouring concentrated pesticides. Rubber or neoprene are recommended but they should be washed very soon after use as the chemical may penetrate into the material. Do not wear leather or cloth gloves. These materials soak up the chemical and become a source of continuous contamination. Gloves with holes should not be worn. The sleeves of the coveralls should be worn outside the gloves to prevent spills and splashes from running into the gloves.

e. *Goggles:* Eyes should be protected with goggles, which are resistant to chemicals and have ventilation to prevent fogging.

f. *Respirators:* PERMANENT RESPIRATORS have one or two cartridges screwed on to a facepiece. Each cartridge contains a prefilter which removes dust particles and a filter of activated charcoal which absorbs the chemical. The cartridges are unscrewed and discarded as soon as any odour of the pesticide is detected in the facepiece. Permanent respirators are cleaned after each day's use: unscrew the cartridges and wash the facepiece with soap and water. Rinse the facepiece in clean water, dry with a clean cloth, and screw on the cartridges. The clean respirator should be stored in a sealed plastic bag to prevent cartridges from absorbing air borne contaminants. DISPOSABLE RESPIRATORS have the prefilter and filter in one cartridge that is permanently attached to the facepiece. The entire respirator is discarded when any odour is detected in the facepiece. These respirators should also be stored in a sealed plastic bag. **SPECIAL NOTE:** Farmers should buy respirators and cartridges approved for use with pesticides. Gauze and dust masks are not respirators and are not recommended for pesticide dusts.

g. *Gas Mask:* These are used when a farmer is likely to be exposed to **very high levels** of pesticides. The facepiece covers the eyes, nose and mouth. It is connected by a flexible hose to a charcoal canister worn on the belt. The lifespan of this canister is longer than that of the respirator cartridges. Manufacturer's directions are to be followed for cleaning and storing gas masks and canisters.

4. SAFETY EQUIPMENT STORES

Safety clothing and equipment are sold by Alberta Wheat Pool, Cargill Grain, U.F.A. Coop, Fleck Bros., Levitt Safety, and Safety Supply.

5. POISON INFORMATION CENTRES

The emergency department of most hospitals can deal with pesticide poisoning. However, there are three hospitals within the province with additional information on pesticide poisoning.

University of Alberta Hospital	Calgary General Hospital	Foothills Hospitals
83 Avenue & 112 Street	841-Centre Avenue E.	1403-29 Street N.W.
Edmonton, Alberta	Poison Control Centre: 262-5982	Calgary, Alberta
General Information: 432-8822	EMERGENCY Department: 268-9625	EMERGENCY Department: 270-1315

Some manufacturers have emergency telephone numbers to call in case of pesticide poisoning.

Chipman Incorporated	Monsanto Canada Inc.	Cyanamid Canada Inc.	Union Carbide
Tel: 1-416-528-6771	Tel: 1-314-694-1000	Tel: 1-416-356-8310	Tel: 1-514-645-5311
1-416-643-4123			

6. STANDARD FIRST AID MEASURES

Before using a pesticide, look for the hazard symbol on the label. This indicates the toxicity of the pesticide. If you are severely exposed to a pesticide and you are alone, DO NOT PANIC. The symptoms of the pesticide do not show up immediately. You will have some time to decontaminate yourself. Get any spilled pesticide off your body immediately. If the pesticide is on your clothes, remove them and rinse your skin with water. After rinsing, wash the area with soap and water. If you splash or spill pesticide in your eyes, wash eyes with water at once. Hold the eyelids open and wash eyes for at least 15 minutes with fresh water each time. Get help to take you to the emergency department of the nearest hospital and take the labelled container with you. Do not use any eye medication unless prescribed by a doctor.

Accidentally swallowing - read the label under FIRST AID INSTRUCTIONS to determine whether or not to induce vomiting. Usually if the formulation contains PETROLEUM DISTILLATES, vomiting should NOT be induced. If the label recommends vomiting, do so at once. Induce vomiting by drinking 1 or 2 glasses of water then sticking finger down throat **OR** swallowing syrup of ipecac (adult doses 30 mL; children under 12 years, 15 mL) followed by water to enhance vomiting. Do not induce vomiting in an unconscious or convulsive person. The person could choke to death on the vomit fluid. Get to the nearest hospital as soon as possible.

7. OTHER PRECAUTIONS AND SAFETY TIPS

a. Bees may be affected by pesticides or honey may be contaminated. Avoid spraying near hives or contaminating puddles of water from which bees may drink. Spray early in morning or late in afternoon when bee activity is at minimum. Warn beekeepers of your intentions so they can confine the bees or move them until spraying is over.

b. Make sure herbicide containers are completely empty when you are finished. Rinse the container with water 3 times and adding the wash water to sprayer tank. The container is virtually clean and may be disposed of at an approved pesticide container collection site. Consult your local district agriculturist if a collection site does not exist in your area. Never reuse the container for other purposes.

c. Control systems using electrically operated solenoid valves are available. These allow sprayers to be controlled remotely, preferably from within a cab. Cabs provide some protection against spray drift and a good tight cab with filtered air intake should reduce but not eliminate operator exposure.

PLANT GROWTH REGULATORS (PGR'S)

Plant Growth Regulators (PGR's) are chemicals which affect the normal growth process of plants. Unlike herbicides, they are generally used on crop plants for beneficial effects such as increased yield, promotion of flowering, reduction in lodging, etc. At present, Cerone in the only PGR registered for use in Alberta.

SOIL STERILANTS

Soil sterilants are growth preventers. They are poor killers of older weeds; they should be applied in the spring before growth begins or in the fall after growth ceases (before ground freezes). If application is made to established growth use a top kill material with the sterilant.

Water volume required for application of the soil sterilants is not critical, but even distribution over the ground surface is. Depending upon equipment used and foliage density this may vary between 100 and 1000 L/ac.

Soil sterilants are generally sold as wettable powders. Continuous gentle agitation is required to prevent settling out - heavy agitation will cause foaming and application problems. Make a slurry of the chemical in a separate container - fill the sprayer tank one half full of water - and while filling the tank with water and with the agitator operating pour the slurry into the tank. The agitator should not be stopped until the tank is empty. If by-pass agitation is used ensure the line enters the bottom of tank to minimize foaming.
All screens and filters throughout the spraying system should be no finer than 50 mesh. Never use felt filters.
After using soil sterilants the equipment should be thorougly washed, and rinse water disposal on the treated site.
Most sterilants are relatively insoluble and become attached to soil particles - however heavy rainfall may cause physical movement of both chemical and soil particles and if the slope is steep movement will be substantial. Remember that after use of these products there will be no plant growth to slow erosion.
Bare ground will be maintained for 12-14 months after application. After this time chemical will have moved out of the top 2-3 cm of the soil surface and shallow rooted annual weeds and grasses will germinate. As they develop and send roots deeper into the chemical layer they will die, however there will always be new seeds germinating. By 24 months after application the "clean" layer of soil may be 6-8 cm deep and weed growth will be more obvious. At this time it may be necessary to apply a lower, reinforcing treatment of the soil sterilant.
Each product will leave a group of plants which are slightly tolerant. If more than two successive applications are made results will appear quite unsuccessful as these tolerant plants will predominate. The solution is to rotate products.

NITRATE POISONING DUE TO HERBICIDE ACTION

Nitrates are the major form in which plants take up nitrogen to be used by the plant for making protein and other nitrogen compounds that are important for plant life and growth. In normal circumstances nitrates are converted to these other products at about the same rate that they enter the plant. Under some conditions nitrates accumulate because they are entering the plant faster than they can be converted. Nitrates combines with blood hemoglobin reducing oxygen utilization. The poisoned animal can die from suffocation.
Nitrate accumulations may be due to leaf damage due to frost, hail or herbicide action. After severe frost, hail or herbicide damage the nutrient value of the crop will decrease rapidly. From a feed value point of view it is important to harvest as soon as practical - however in the case of herbicide treated crops there may be a waiting period specified on the label and in the case of high risk crops, such as oats or corn a delay may be advisable to permit nitrate levels to decrease.
If there is a possibility of high nitrates in a feed, have it analysed at a feed testing laboratory. A veterinarian should be called immediately if livestock are showing unusual symptoms when they are being fed forages containing nitrates. Symptoms of nitrate poisoning include reduced milk production and growth rate, abortions and in severe cases death by suffocation.

SPRAYER CALIBRATION

Sprayer calibration consists of adjusting speed, pressure and nozzles to produce the desired spray volumes. Pick the spray volume desired, mix the chemical and water to the correct strength and operate the sprayer at the speed and pressure that will provide the correct application rate.
Spray volume, pressure and nozzle spacing are all standardized for each chemical and nozzle type.
All that remains for the operator to do is to select the nozzle tip that provides the desired spray volume at a convenient speed; or to pick the correct speed (if nozzles are already determined) and to mix the chemical accordingly.
This system of calibration requires that the sprayer is in good working order, that the nozzles are not worn out and that the gauge provides a true reading of pressure at the nozzle.
The spray pattern must be uniform along the entire boom. To achieve a uniform pattern there are several conditions that must occur simultaneously:

1. Pressure must be set correctly.
2. Spray patterns from each nozzle must not be streaky.
3. Output from all nozzles must be equal.
4. Distance of nozzle tip from target must be correct.

The following steps are suggested to ensure that the sprayer is in good working order so that correct calibration can be achieved.

1. Remove and clean nozzles, screens and filters.
2. Check that nozzles are all the same size and spray angle.
3. Flush the entire system and install filters, screens and nozzles.
4. Check boom pressure with an accurate gauge and compare to sprayer gauge (they should be identical). If boom gauge reads lower, check for a flow restriction.
5. With pressure set at 275 kPa, clean or replace streaking nozzles then collect spray from each nozzle and compare to manufacturers specifications. Replace nozzles that vary by more than 5% of specifications. (nozzle chart in this section)

NOTE: *If ball check valves are being used an extra 35 kPa pressure is required to account for flow restriction. Diaphragm check valves do not require extra pressure.*

Once it has been established that the sprayer is operating correctly the spray volume can be determined from the nozzle chart. The spray volume is controlled by varying forward speed. **Do not change pressure setting.**

Example: If a sprayer is equipped with nozzle tips other than the STANDARD tips and the nozzle chart does not indicate at which speed that nozzle will provide 40 L/ac it will then be necessary to establish that speed.

eg. (from chart)

Nozzle No. 80015 provides 46 L/ac at 275 kPa and 6 km/h. To find which speed will provide 40 L/ac multiply: known L/ac x known speed, then divide by required L/ac

46 L/ac x 6 km/h = 276, then divide by 40 L/ac = 6.9 km/h.

SAMPLE NOZZLE CHART

Nozzle Type				Litres per Acre 50 cm spacing			
Teejet	Delavan	Pressure kPa	Output per Minute Litres	6 km/h	8 km/h	9 km/h	10 km/h
8001	LF 1-80	275	0.37	30	23	20	18
80015	LF 1.5-80	275	0.56	46	34	31	28
8002*	LF 2-80	275	0.75	61	46	40	36

*STANDARD Tips for 40 L/ac at 275 kpa and 9 km/h.

Following is an example of how a sprayer can be calibrated.

SPRAYER CALIBRATION GUIDE

Litres Per Acre (L/ac)

PROCEDURE	*EXAMPLE*
Step 1 Field size	50 Acres
Step 2 Spray tank capacity	1800 Litres
Step 3 Spray volume (standard is 40 L/ac)	40 Litres per acre
Step 4 Select nozzle (from chart) that applies 40 L/ac	8002 = 40 L/ac at 275 kPa and 9 km/h
Step 5 Total spray volume (acres x L/ac)	50 ac x 40 L/ac = 2000 L

NOTE: SPRAY TANK HOLDS 1800 LITRES. AT 40 L/ac, ONE FULL TANK COVERS 45 ACRES. A SECOND TANK WITH 200 L OF TOTAL SOLUTION IS NEEDED TO FINISH THE LAST 5 ACRES.

	Example: label states 0.6 L/ac
Step 6 Amount of chemical to add:	0.6 L/ac x 45 ac = 27 L in full tank;
(rate per acre x no. of acres)	0.6 L/ac x 5 ac = 3 L in second tank

Step 7 Set pressure at 275 kPa and drive at 9 km/h (ground speed chart)

GROUND SPEED CHART

Speed	Time to Travel 0.8 km (0.5 mi)		Speed	Time to Travel 0.8 km (0.5 mi)	
km/h	Minutes	Seconds	km/h	Minutes	Seconds
6.0	8	0	8.5	5	38
6.5	7	22	9.0	5	20
7.0	6	52	9.5	5	3
7.5	6	24	10.0	4	48
8.0	6	0			

NOTE: Speed check should be done on a soil surface similar to that which will be sprayed. For nozzles or speeds not included refer to manufacturer's data or *Guide To Crop Protection In Alberta Part III - Pesticide Application Equipment.*

If spray charts are not available for your nozzles the following formula may be used to establish their spray volume at a set pressure and speed.

$$\frac{24{,}282 \times \text{L/minute (one nozzle)}}{\text{km/h} \times \text{nozzle spacing (cm)}} = \text{L/ac}$$

First:

1. Adjust pressure to recommended setting (label).
2. Measure output of one nozzle (all nozzles must be equal).
3. Establish ground speed you will use.
4. Measure nozzle spacing (usually 50 cm).

Then use the above formula.

Example: 8002 nozzle at 275 kPa has an output of 0.75 L/minute and will apply 40 L/ac at 9 km/h (from chart).

$$\frac{24{,}282 \times .75 \text{ L/minute}}{9 \text{ km/h} \times 50 \text{ cm spacing}} = 40 \text{ L/ac}$$

AIRCRAFT APPLICATION

Aircraft applicators must take care to get even distribution of pesticides, and avoid damage to crops. The following suggestions are offered to help minimize these hazards.

a. To get best coverage of crops and minimize the loss of spray to the atmosphere, spray in winds under 15 km/h. For best results apply herbicides in volumes not less than 14 L/ac. Fly as low as is safe. Width of swath should not be more than 1.25 of wingspan. Space the nozzles on the boom to give uniform distribution in the swath in spite of swirl from propeller and vortexes at the wing tips.

b. To Avoid Drift Damage from Aircraft application.
Do not spray when wind is blowing toward a sensitive crop, shelterbelt or garden. Safe distances cannot be given. Do not spray in dead calm near sensitive plants. Do not apply volatile herbicides near a sensitive crop, shelterbelt or garden since the vapors rising from the field after application may be blown onto these plants.

c. To Avoid Injury to Crops
Use water as a carrier in preference to oil as injury is less likely. Apply at "safe" growth stage of the crop. Select the best chemical for the crop and weeds that are present and use only enough material for the degree of control desired.

CONVERSION TABLES

Benchmarks

Standard Application Volume:
40 litres per acre (L/ac) = 100 litres per hectare (L/ha)

Standard Spraying Pressure:
275 kilopascals (kPa) = 40 pounds per sq. inch (psi)

Standard Speed For Spraying:
9 kilometres per hour (km/h) = 5.6 miles per hour (mp/h)

Standard Nozzle Spacing On A Spray Boom:
50 centimetres (cm) = 20 inches (in)

Standard Height Above Target for 80 Degree Nozzle Tips:
45 centimetres (cm) = 18 inches (in)

Standard Nozzle Tips:
TeeJet 8002 or Delavan LF 2-80

Metric Equivalents

1 acre	=	0.405 hectare
2.471 acres	=	1 hectare
6.9 kPa	=	1 psi
1.6 km/h	=	1 mp/h
2.54 cm	=	1 inch
1 Litre/ac	=	2.5 L/ha

NOTE: A standard nozzle has an output of 0.75 litres per minute at 275 kPa. At 9 km/h these nozzles will apply 40 litres of spray per acre.

GLOSSARY OF TERMS IN PEST CONTROL

Active ingredient(a.i.)	The concentration of chemical in a formulated product that is responsible for action.
Adjuvant	A substance added to a pesticide formulation or mix to improve the physical properties of that pesticide and hence its effectiveness. e.g. wetting agents, spreaders, stickers, and emulsifiers.
Antagonism	Opposing action of different chemicals such that the sum of their total effect is less than the effect if each pesticide were used alone.
Antidote	A first aid treatment to offset the toxic effect of a pesticide.
Bioassay	Determination of concentration of a herbicide by use of a sensitive indicator plant.
Carrier	Liquid or solid used to facilitate application of a pesticide.
Chlorotic	Loss or fading of green colour in foliage.
Contact herbicide	A herbicide that causes localized injury to plant tissue, only where contact occurs.
Crop canopy	Covering or umbrella of crop plants over weeds and ground below.
Degradation	Breakdown of a pesticide by action of air, water, sunlight microbes or other agents.
Desiccant	Chemical used to accelerate drying of plant tissues.
Efficacy	Effectiveness of chemical on the pest.
Foliar application	Made to the leaves of plants, as opposed to soil application.
Formulation	Form in which the manufacturer prepares a pesticide to facilitate its use - granular, solution, emulsifiable concentrate, dry flowable, liquid flowable, wettable powder.
Fumigant	Vapour active chemical used against pests.
Half-life	Time required to breakdown 50% of a pesticide.
Headland	Field margin or roadway.
Incompatibility	Where one pesticide cannot be satisfactorily mixed with another - Mixture may gel, lose activity, settle out or be phytotoxic.
Inhibit	Prevent or stop a process e.g. inhibits photosynthesis.
Metric measurements	mm = millimeter = .001 m; mL milliliter = .001 L; g = gram = .001 kg; kg = kilogram = 1000 g.
Necrosis	Localized death of plant tissue - usually characterized by browning and desiccation.
Photosynthesis	Process by which green plants use sunlight, carbon dioxide and water to produce plant food.
Phytotoxic	Injurious to a plant.
ppb	Part per billion. **ppm** Parts per million.
Residual herbicide	Persists in soil, kills regrowth and/or germinating seedlings over an extended time.
Soil sterilant	A soil-applied herbicide intended to kill all plant life for an extended time.
Spray drift	Movement of airborne spray droplets beyond the target area.
Synergism	Complementary action of different pesticides such that the total effect is greater than the sum of their independent effects.
Systemic pesticide	One that is able to move in the plant from the initial point of contact.
Translocation	Process by which substances move within a plant.

AFOLAN F (Ilnuron)
Hoechst

1. FORMULATIONS: Dispersible - 450 g/L - 8 L containers.
2. REGISTERED MIXES: Afolan F+MCPA amine.
3. CROPS:

Afolan F

asparagus (8.7)
carrots (8.2)
celery (9.0)
corn(field, sweet)(8.5)
dill (6.8)
parsnips (7.0)
potatoes (8.7)
shelterbelts (9.0)

Afolan F+MCPA (amine)

barley; oats
spring wheat

4. WEEDS CONTROLLED:

Afolan F

barnyard grass (8.3)
buckwheat, wild (8.5)
chickweed, common (9.0)
corn spurry (8.7)
dandelion, seedling (6.0)
foxtail, yellow (6.2)
goosefoot (8.4)
groundsel (8.6)
knotweed
kochia (6.4)
lamb's-quarters (7.9)
mustard, wormseed (6.0)
panicum, fall
pigweed (prostrate (8.7),
redroot (7.9))
purslane (8.4)
radish, wild
ragweed, common
shepherd's-purse (9.0)
smartweed, annual (9.0)
sow-thistle, perennial seedling
stinkweed (8.5)
velvetleaf

Afolan F+MCPA amine

buckwheat
(Tartary(7.9), wild(7.5))
burdock
chickweed, common (7.4)
cocklebur
cow cockle (6.8)
goat's-beard
hemp-nettle (7.5)
kochia (5.8)
lady's-thumb
lamb's-quarters (8.9)
lettuce, prickly
mustard (ball, hare's-ear, Indian,
tumble, wild, wormseed)(8.8)
pigweed (prostrate (8.0),
redroot (7.8), Russian)
radish, wild
ragweed (common, giant (9.0))
shepherd's-purse
smartweeds, annual (7.0)
stinkweed (8.9)
stork's-bill (8.3)

5. WEEDS SUPPRESSED: Green foxtail, field horsetail.
6. WHEN USED: **Afolan F:** ***Asparagus, potatoes:*** pre-emergent. ***Carrots, parsnips, dill:*** 2 or more leaves; before grassy weeds 5 cm tall, broad leaved weeds 15 cm. ***Celery transplants:*** as soon as new growth starts. ***Fruit trees:*** directed spray around trunk of trees established at least 10 years. ***Shelterbelts:*** apply before or immediately after weeds emerge, before 15 cm tall; no earlier than 10 days after transplanting. After buds open, apply as a directed spray. ***Corn (field, sweet):*** before corn emerges or as a directed spray on weeds after corn is at least 38 cm tall. **Afolan F+MCPA amine:** ***Spring wheat, barley, oats:*** when crop in 2-4 leaf stage and weeds in 1-4 leaf stage. Do not apply after tillering.
7. HOW TO APPLY:
   With: Ground equipment.
   Rate: ***Wheat, barley, oats:*** Afolan F - 200-250 mL/ac+MCPA amine 500: 440 mL/ac - lower rates when above average growing conditions and rainfall. ***Asparagus:*** Afolan F 1.5-2.0 L/ac. ***Carrots, parsnips, dill:*** Afolan F 575 mL-2.0 L/ac - higher rate on larger established weeds. ***Celery transplants, corn (field, sweet), potatoes:*** Afolan F 1.1-2.0 L/ac. ***Shelterbelts:*** Afolan F 4.0 L/ac. ***Fruit trees:*** Afolan F - 4.0 L/ac. **Application method:** Afolan F+MCPA amine 500 - 40 L/ac water - 275 kPa - 9 km/h. Screens 50 mesh or larger - 80 x flat f&n nozzles - adequate agitation required. Afolan F - 40-160 L/ac except on shelterbelts and fruit trees - directed spray required.
8. SPRAYING TIPS: Early application will avoid crop injury. Barley may suffer growth suppression, maturity delay and yield reduction which may be offset by control of heavy weed growth. Use only MCPA amine in mix to avoid crop injury, do not use very hard water with MCPA amine, and ensure adequate agitation. To avoid settling, spray soon after mixing. Make only 1 Afolan F application per crop year. Do not apply to crops under drought, heat or frost stress.
9. HOW IT WORKS: Afolan F: both systemic and contact, absorbed by roots and leaves. MCPA: systemic, absorbed by leaves.
10. EXPECTED RESULTS: First, browning of older leaf tips, then water soaked, wilted appearance, progressive yellowing, stem collapse, browning and death. MCPA promotes stem bending, twisting, leaf cupping. Incorrect timing of application, stress conditions, crusted soil or rain immediately after spraying will cause poor results.
11. EFFECTS OF RAINFALL: Requires rainfall or irrigation for activation of pre-emergent applications. Rainfall within 1 hour may decrease post-emergent effect. Unusually heavy rains after a pre-emergent application may cause severe injury to corn, carrots, or parsnips. Afolan F+MCPA amine - rainfall within 4 hours will detract from results.
12. MOVEMENT IN SOIL: Higher rates of Afolan F and extreme moisture may cause some leaching.
13. GRAZING AND CROPPING RESTRICTIONS: Do not graze or feed green plants to livestock. Do not apply within 60 days of harvest. No restriction on succeeding crops except if 2.0 L/ac or more is applied (possible 25% carryover to next season).
14. TOXICITY: Very low mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,500). May irritate eyes, skin, nose and throat. Toxic to fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical aid in all cases.
16. STORAGE: Do not store below 5°C. If stored for 1 year or longer, shake well before using.

AMIBEN (chloramben)
Union Carbide

1. FORMULATIONS: Solution - 240 g/L - 22.7 L containers. Granular - 10% - 22.7 kg bags.
2. REGISTERED MIXES: A tank mix of Amiben + Treflan for sunflowers.
3. CROPS: Asparagus (8.4), lima beans, pumpkins, red kidney beans, snap beans, squash, white (dry) beans (9.0). Amiben + Treflan - sunflowers (9.0) Underseeding: Not recommended.
4. WEEDS CONTROLLED:

barnyard grass (7.5)	foxtail	pigweed, redroot	smartweed, annual (7.9)
chickweed, common (9.0)	(green (6.1), yellow (5.1))	pigweed, prostrate (6.2)	stinkweed (8.0)
	lamb's-quarters (6.7)	ragweed	
	mustard, wild (8.3)		

5. WEEDS SUPPRESSED: None
6. WHEN USED: Pre-plant incorporated or post-plant pre-emergent.
7. HOW TO APPLY:
   With: Ground equipment.
   Rate: Asparagus, snap beans, squash, pumpkins - 3.8-5.6 L/ac. lima beans - 5.6 L/ac. White beans - 3.8 L/ac. Red kidney beans - 5.6 L/ac. Sunflowers - 3.7 L/ac Amiben plus 1.1 L/ac Treflan on medium to heavy soils or 800 mL/ac Treflan on light soils.
   Water Volume: 40 L/ac
   Incorporation: Not required for vegetable crops. Thoroughly incorporate within 8 hours into the soil in 2 directions at right angles to each other for sunflowers. Set implements to cut 8.0-10.0 cm deep.
   Pressure: 275 kPa
   Ground Speed: Operate disc implements at 6-10 km/h, cultivators 10-13 km/h.
8. SPRAYING TIPS:
   (a) For proper incorporation follow Treflan label.
   (b) Seed sunflowers within 1 week of application.
   (c) A light cultivation with a vegetable crop will increase weed control when there is inadequate moisture to move the Amiben down but enough moisture to germinate the weeds.
9. HOW IT WORKS: Requires moisture for activation, it inhibits root development of seedling weeds for several weeks.
10. EXPECTED RESULTS: ***Wild Mustard and Stinkweed:*** Affected seedlings will not emerge from the ground. Control of cruciferous species will last for at least 6-8 weeks following treatment. ***Poor results may be expected if:*** (a) Application and incorporation when soil surface is wet. (b) Inadequate soil incorporation or the use of improper incorporation equipment. (c) Insufficient moisture to carry the chemical into the soil.
11. EFFECTS OF RAINFALL: In light soils a heavy rainfall may wash Amiben below the root zone of germinating weed seeds.
12. MOVEMENT IN SOIL: Water soluble.
13. GRAZING AND CROPPING RESTRICTIONS: None.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (3,500). May be a skin irritant. Non-toxic to fish and birds.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Store in heated area. If freezing occurs store in a warm room at 10-27°C for several hours and agitate thoroughly before using to ensure all crystals are dissolved.

AMITROL-T (amitrole)
Union Carbide

1. FORMULATIONS: Solution - 200 g/L - 1 and 10 L containers.
2. REGISTERED MIXES: None.
3. CROPS: Spot treatment - pastures, shelterbelts, roadsides, fence rows, ditch banks. Total non-selective vegetation control.
4. WEEDS CONTROLLED:

Canada thistle (7.4)	hoary cress	quackgrass (5.3)	toadflax
cattails	leafy spurge	showy milkweed	most annual weeds
field horsetail (8.2)	poison-ivy	sow-thistle (annual, perennial)	

5. WEEDS SUPPRESSED: None.
6. WHEN USED: Canada thistle and sow-thistle (annual, perennial) - bud to bloom, hoary cress - rosette to bud, cattails - bud to seed, field horsetail - no restrictions, leafy spurge - seedlings to bloom, toadflax - rosette to pre-bud, quackgrass - 15 to 30 cm, showy milkweed - 5-30 cm. Crops - non-selective - spot treatment only.
7. HOW TO APPLY:
   With: Ground equipment, hand sprayer.
   Rate: Canada thistle, sow-thistle, quackgrass, toadflax, showy milkweed, hoary cress - 9-14 L/ac; leafy spurge, cattails - 18-22 L/ac; poison ivy - 4.5 L/ac.
   Water Volume: 80-200 L/ac
   Pressure: 150-275 kPa
   Ground Speed: Spot treatment.
8. SPRAYING TIPS: Spray to point of run-off, complete coverage of weeds essential. Do not till or mow for 3 weeks.
9. HOW IT WORKS: Systemic herbicide which inhibits chlorophyll production. Moves through foliar and root system.
10. EXPECTED RESULTS: Whitening begins in 7-14 days and plants die. Short term residual. ***Poor results may be expected if:*** poor coverage, inadequate rate, plants over mature or under drought stress. Tillage too soon after application.
11. EFFECTS OF RAINFALL: Heavy rain within 10-12 hours reduces effectiveness.
12. MOVEMENT IN SOIL: At recommended rates - persists in soil 4-6 weeks.
13. GRAZING AND CROPPING RESTRICTIONS: Do not graze treated area for 6 months. Most crops susceptible to drift.
14. TOXICITY: Oral LD_{50} rats (mg/kg) = (24,600). May be irritating to skin and eyes; has potential to cause health problems after prolonged, continuous exposure. Non-toxic to fish and birds.
15. PRECAUTIONS, FIRST AID: Do not apply on foraging bees. Wear standard protective clothing (see page 2) to avoid exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Do not freeze or store above 50°C. No shelf life limitation. If frozen, contents will crystallize - to resuspend warm to 27°C and agitate as necessary.

AMIZINE (amitrole + simazine)
Union Carbide

1. FORMULATIONS: Solution - Amitrol - 53 g/L + simazine 106 g/L - 20 L pack.
2. REGISTERED MIXES: None. Mix restrictions: See "Soil Sterilants" page 4.
3. CROPS: Industrial sites and non-cropped areas only.
4. WEEDS CONTROLLED: All broad-leaved weeds and grasses.
5. WEEDS SUPPRESSED: Not applicable.
6. WHEN USED: Apply in spring or early summer - weeds small - dandelion, green foxtail, kochia, lamb's-quarters, annual smartweeds, plantain, purslane, wild oats, redroot pigweed, grasses - 1-19 cm tall.
7. HOW TO APPLY:
   With: High volume ground sprayer - hand sprayer.
   Rate: Ground sprayer - 35 L/ac - hand sprayer 800 mL/100 m^2
   Water Volume: 200 L/ac - hand sprayer 8-12 L/100 m^2
   Pressure: 275 kPa
   Nozzles: Tee-Jet 8002 or larger fan nozzles.
8. SPRAYING TIPS: Use no finer than 50 mesh size screens.
9. HOW IT WORKS: absorbed by roots and moves through plant. Affects chlorophyll - plant whitens and dies slowly. Simazine remains in soil giving control for 1 growing season.
10. EXPECTED RESULTS: Plants turn white in 7-14 days and are usually dead in 3 weeks. Area should remain weed free for 1 season.
11. EFFECTS OF RAINFALL: Rainfall will carry chemical into root zone and speed action.
12. MOVEMENT IN SOIL: adsorbed on soil particles and resists leaching by rainfall.
13. GRAZING AND CROPPING RESTRICTIONS: not applicable. Lilac, privet, honeysuckle, barberry are very susceptible to drift.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = amitrole (24,600), simazine (5,000). Has potential to cause health problems after prolonged, continuous exposure or may cause dermatitis. Non-toxic to fish and birds. May be toxic to bees.
15. PRECAUTIONS AND FIRST AID: Do not apply when bees are foraging. Wear standard protective clothing (see page 2) to avoid exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Do not freeze to avoid crystallization. If frozen, warm, agitate until crystals redissolve.

ASULOX F (asulam)
May and Baker

1. FORMULATION: Solution - 400 g/L - 20 L pack.
2. REGISTERED MIXES: Asulox F + Buctril M (Flax). Asulox F + Embutox (seedling and established alfalfa grown for seed). Mix restrictions: Add the required amount of Buctril M and mix, then add Asulox F.
3. CROPS: Flax (8.3), seedling and established alfalfa, grown for seed (8.3). Underseeding - Flax undersbeded to alfalfa.
4. WEEDS CONTROLLED: Wild oats (7.8).
5. WEEDS SUPPRESSED:

barley (3.3)	buckwheat, wild (5.3)	oats, volunteer (6.7)	stinkweed (8.6)
barnyard grass	foxtail, green (6.3)	smartweed, annual (7.1)	wheat (3.0)
bluebur	mustard, wild (8.0)		

6. WHEN USED: 2-4 leaf stage of wild oats when flax 2.5-15 cm tall. Alfalfa when beyond first trifoliate leaf stage.
7. HOW TO APPLY:
   With: Ground equipment. Floaters not recommended.
   Rate: 1.1 L/ac
   Water Volume: 20-40 L/ac
   Pressure: 275 kPa
   Nozzles: Flooding tips are not recommended.
8. SPRAYING TIPS:
   (a) Do not spray unthrifty crops or flax under stress due to drought or excess soil moisture.
   (b) Do NOT spray in hot, humid weather conditions or when crop is wet with dew.
   (c) Flax will likely sustain injury if grown on low fertility soils.
9. HOW IT WORKS: Absorbed by leaves and translocated; inhibits cell division in the growing points of the plant. Symptoms are severe yellowing of new leaves, stunting and finally death. Growing points are killed within 1-2 weeks but full effect occurs by the fourth week.
10. EXPECTED RESULTS: ***Wild oats:*** Start to yellow about 1 week after application. Wild oat plants not at the recommended growth stage or those that emerge after spraying will be unaffected. ***Crop:*** Temporary slight yellowing of the flax leaves may occur a few days after spraying. Crop recovery from wild oat competition may be slow if the weeds have been allowed to smother the flax. Stunting and delay in maturity may be noticed. ***Poor results may be expected:*** with incorrect spray volume or ground speed; improper stage of wild oats; spraying when foliage is wet with dew; spraying when flax is under stress or in hot, humid weather.
11. EFFECTS OF RAINFALL: Rainfall within 8 hours may seriously affect activity.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Danger from drift is low, but cereals may be slightly yellowed. ***Grazing Restrictions:*** Do not graze or feed crop.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (5,000). Non-toxic to birds, fish and bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to prevent contact with skin and eyes. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Heated storage. If frozen, redissolve crystals by storing in a warm room and thorough agitation.

ATRAZINE

Ciba-Geigy / Chipman

1. FORMULATIONS: Aatrex Liquid - Ciba Geigy - Liquid 500 g/L - 10 L pack. Aatrex Nine-0 - Ciba Geigy - 90% water dispersible granule - 4.5 kg and 10 kg bag. Aatrex Plus - Ciba Geigy - flowable - 400 g/L + 25% oil concentrate - 20 L container. Atra-Mix - Chipman - flowable - 400 g/L + 25% oil concentrate - 2 x 10 L/case. Atrazine F - Chipman - 500 g/L - 2 x 10 L/case. Atrazine 90W - Chipman - 90% WP - 10 x 2 kg/case.

2. REGISTERED MIXES: Aatrex Plus and Atra-Mix - none. Aatrex Nine-O, Aatrex Liquid - with corn oil concentrate, nitrogen solutions or complete liquid fertilizers, Dual Ciba-Geigy 960, Bladex and Sutan +.

3. CROPS: All corn.

4. WEEDS CONTROLLED:

Atrazine	lamb's-quarters	oats, wild	**Atrazine + Dual Ciba-Geigy**
barnyard grass	mustards	pigweed, redroot	foxtail (green, yellow)
buckwheat, wild	purslane	smartweed	
clover, volunteer	ragweed		

5. WEEDS SUPPRESSED: None.

6. WHEN USED: Aatrex Nine-O, Aatrex Liquid, Atrazine F, Atrazine 90W - pre-plant, pre-emergent, post-emergent or band applied. Aatrex Plus, Atra Mix - mainly post-emergent but may be used pre-emergent, after planting corn.

7. HOW TO APPLY:
With: Ground equipment.
Rate: ***Aatrex Liquid*** - 1.3-2.7 L/ac. ***Aatrex Liquid*** 1.3-1.8 L/ac + 6.9 L/ac emulsified oil in 60-120 L/ac of water. ***Aatrex Nine-O*** - 0.8-1.5 kg/ac. ***Aatrex Plus*** - 1.7 L/ac. ***Atra-Mix*** - 1.8 L/ac on light, sandy soil; 2.3 L/ac on loam or clay; 3.4 L/ac on high organic soils. **NOTE:** Vary rates according to different soil types.
Quackgrass Control: Atra-Mix and Aatrex Plus - Apply 2.2 L/ac to quackgrass foliage in fall or early spring. Cultivate 1-3 weeks later, plant corn. Repeat chemical treatment as early post-emergent.
Water Volume: 60-120 L/ac
Incorporation: Only Aatrex Liquid and Aatrex Nine-O are applied pre-plant; Aatrex Plus can be applied as pre-emergent. Do not incorporate deeper than 5.0 cm.
Pressure: 200-300 kPa

8. SPRAYING TIPS:
(a) Do not mix oil concentrates, surfactants or hormone type herbicides with any mixture of Atrazine plus Bladex.
(b) When preparing a tank mix - add Atrazine to the tank of water first, agitate, add Bladex slowly and agitate thoroughly.
(c) Continuous gentle agitation is needed, but avoid excessive agitation, especially with mixtures with oil, or a grease like mass may form.
(d) Use 50 mesh or larger strainers and use only metal filters.
(e) Bypass line should discharge to bottom of tank.
(f) If mixes containing oil are used, use at once and clean tank and system with a strong detergent solution.
(g) Band treatments are desirable when cultivation is to alleviate hard soil conditions or to control annual weeds.

9. HOW IT WORKS: Inhibits photosynthesis.

10. EXPECTED RESULTS: Weeds slow to emerge or under drought conditions will be killed when moisture improves. Heavy rainfall on sandy soils may cause leaching, a decrease in efficacy and off target injury.

11. EFFECT OF RAINFALL: Rainfall will activate the chemical, carrying it into the root zone where kill will begin.

12. MOVEMENT IN SOIL: Heavy rainfall on sandy soils may cause leaching and soil movement.

13. CROPPING AND GRAZING RESTRICTIONS: Plant only to corn in year of treatment. Sugar beets should not be planted for 2 years following the growing season in which Atrazine is used. Crops most tolerant to Atrazine, next to corn, are sorghum then flax, fababeans and peas. Latter crops may be seeded in the season following Atrazine application if rates were not greater than 40 g/ac of active Atrazine. Crop injury to succeeding crops may occur if there is an extended period of dry weather during year of treatment. Injury is most likely to occur on seedling crops subjected to periods of stress such as hot, dry weather. ***To reduce Atrazine residues:*** Thorough tillage, including ploughing should precede the planting of crops other than corn. Uneven application of Atrazine or application in excess of recommended rates will not injure corn but may result in injury to other succeeding crops.

14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (3,080). May cause eye irritation. Low toxicity to fish and birds.

15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF AATREX PLUS or ATRA-MIX SWALLOWED - do NOT induce vomiting. Get medical attention. IF AATREX LIQUID, AATREX 90W, AATREX NINE-O or AATREX 80W SWALLOWED - induce vomiting (see page 3). Get medical attention.

16. STORAGE: The flowable formulations should be kept from freezing. If stored in unheated areas the product should be warmed and agitated thoroughly prior to using.

AVADEX BW (triallate)

Monsanto

1. FORMULATIONS: Emulsifiable Concentrate: 400 g/L - 22.7 L Granular 10% - 22.7 kg bags
2. REGISTERED MIXES: Avadex BW + Treflan or Rival. Dry bulk or liquid fertilizers, thorough mixing is essential.
3. CROPS: Barley (8.9), flax (8.9), mustard (9.0), peas (field) (9.0), wheat (durum (8.3), spring), rapeseed (8.2). Underseeding: Alfalfa, clovers, and bird's-foot trefoil may be seeded into Avadex treated soil provided they are not harvested for green feed, silage or hay in the year of seeding.
4. WEEDS CONTROLLED: Wild oats (7.6)
5. WEEDS SUPPRESSED: None
6. WHEN USED: ***Spring:*** Pre-plant incorporated on rapeseed, flax, mustard, peas. Post-plant incorporated on wheat and barley. ***Fall:*** All crops. Granules: September 15 to freeze-up. Liquid: October 1 to freeze-up.
   NOTE: Where soil drifting is a problem, only granules are recommended for fall applications.
7. HOW TO APPLY:
   With: Aircraft (granules only) or ground equipment
   Rate:
   (a) Spring Application

Crops	Application Timing	Organic Matter			
		4% or Less		Greater than 4%	
		Liquid L/ac	Granules kg/ac	Liquid L/ac	Granules kg/ac
Spring wheat	Before seeding	1.2	4.4	1.4	5.7
Durum wheat	After seeding	1.4	5.7	1.7	6.9
Barley	Before and after seeding	1.4	5.7	1.7	6.9
Rapeseed, flax, mustard, sugar beets	Before seeding	1.7	6.9	2.2	8.9
Peas (dry)	Before seeding	1.7	-	1.7	-

   (b) Fall Application

Crops	Organic Matter					
	Less than 2%		2-4%		Greater than 4%	
	Liquid L/ac	Granules kg/ac	Liquid L/ac	Granules kg/ac	Liquid L/ac	Granules kg/ac
Spring and durum wheat	1.2	4.4	1.4	4.4	1.7	6.9
Barley	1.2	4.4	1.4	5.7	1.7	6.9
Rapeseed, flax, mustard, sugar beets	1.4	5.7	1.7	6.9	2.2	8.9

   Water Volume: Liquid only - minimum of 40 L/ac
   Incorporation: Two incorporations at right angles are required for thorough mixing. ***For liquid***, the first incorporation should be completed as soon as possible on the day of spraying. ***For granules***, the first incorporation should be completed within 48 hours of application. The second incorporation for both liquid and granules may or may not be done immediately after the first. For maximum results from spring application of granules, delay second incorporation for at least 3-5 days.
   Implements: Use a double disc or light cultivator plus harrows for pre-plant incorporation. Heavy duty harrows must be used for post-plant incorporation.
   Pressure: Liquid only - 200 kPa.
   NOTE: ***'Not recommended where soil erosion is a problem.***
8. SPRAYING TIPS:
   (a) Use liquid formulation on soils free of trash; use granules on all soils including those with heavy trash cover. For fall application the granule formulation is best suited.
   (b) Incorporation equipment should be operated at 9 km/h.
   (c) Operate double discs and cultivators at a depth of 7.5 cm.
   (d) Do not incorporate into wet soil.
   (e) Straw, lumps of soil, etc. dragged by harrows will cause uneven incorporation resulting in reduced wild oat control.
   (f) On stubble, incorporate with double disc or cultivator followed by harrowing at right angles.
   (g) On fallow, use 2 harrowings at right angles if the soil is loose and free of trash and lumps.
   (h) Incorporation of Avadex BW/urea combination is recommended as follows: ***Spring:*** all crops. Incorporate immediately after spreading. Only pre-plant incorporated applications recommended. For best results delay second incorporation for at

least 3-5 days. ***Fall:*** Applications should be followed immediately by a shallow discing or cultivation. In the spring prior to seeding, a shallow cultivation at right angles to the fall operation is recommended. **NOTE:** Fall application is not recommended where erosion may be a problem.

(i) After seeding, any deep ridges left by drills must be levelled by harrowing.

(j) Drought conditions in the year of treatment may result in higher levels of Treflan/Rival carryover. To avoid wheat injury, seed 6.0-7.5 cm into warm, moist seedbed.

(k) Granules may be applied in the fall prior to or in conjunction with fertilizer banding.

(l) Rapeseed, mustard and flax can be seeded in treated layer. Barley and wheat are more sensitive and should be planted 6.0-7.5 cm. Wheat must be seeded below the treated layer.

9. HOW IT WORKS: Absorbed by wild oat shoots, usually resulting in death before emergence. Under dry conditions wild oats may emerge before being killed.

10. EXPECTED RESULTS: ***Wild oats:*** Usually kills wild oats before they emerge. Scraping away the soil 1-2 weeks following treatment will expose white to yellow wild oats shoots 2.0-2.5 cm in length with pinched tips. Plants which have emerged and absorbed a lethal dose will cease growth, leaves become brittle and bluish-green in color. Under dry conditions, a rainfall of 1.5 cm or more when wild oats are emerging, can cause post-emergent die-back of a high percentage of wild oat plants. ***Crop:*** Wheat seeded into the treatment zone under very dry soil conditions may be thinned and delayed when germinating and emerging just prior to a heavy rainfall. Wheat must be seeded at least 1.5 cm below the treated layer of soil (eg. 5-7.5 cm). ***Poor results may be expected if:*** Incomplete incorporation due to wet, cloddy soil, or heavy trash. Incorporation delayed, very dry soil conditions, in spring or prolonged cool soil temperatures at time of germination. Ridges left by seeding may disrupt the treated layer and allow escapes. Equipment deficiencies such as very light harrows.

11. EFFECTS OF RAINFALL: Moisture is required for activation.

12. MOVEMENT IN SOIL: Negligible

13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** No effect on standing crops. ***Grazing Restrictions:*** None. ***Crop Use After Hail:*** No restrictions. ***Succeeding Crops:*** Oats should not be seeded into soil treated with Avadex BW in the previous year.

14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,675-2,165). May cause slight eye irritation. Slightly toxic to fish, non-toxic to birds.

15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to avoid getting chemical on skin or in the eyes. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - Do NOT induce vomiting. Get medical attention.

16. STORAGE: Store above 0°C. If frozen, warm to 20°C and agitate to redissolve crystals.

AVENGE 200C/640 (difenzoquat)

Cyanamid

1. FORMULATION: Solution - 200 g/L - 20 L. Soluble Powder - 640 g cation/kg, 25 kg.
2. REGISTERED MIXES: Both formulations can be tank-mixed with Torch or Pardner; Buctril M; Brominal M; Bromox 450; Sabre; 2,4-D Ester (wheat and barley only); MCPA ester and with MCPA ester+Torch or Pardner; Glean. Do not apply Avenge+Glean tank mix to canary grass. ***Mix restrictions:*** With agitation running, add broad-leaved herbicide to 1/2 of the water then add the rest of water, and add Avenge 200C. With the Glean mix - ensure Glean is thoroughly dissolved before adding Avenge 200C. Do not add surfactant with 200C/Glean mix. Surfactant required for Avenge 640 is all needed for 640/Glean mix.
3. CROPS: ***Barley:*** all varieties. ***Canary Grass. Fall Rye:*** Cougar, Frontier, Kodiak, Puma, Rymin. ***Spring Wheat:*** Benito, Canuck, Chester, Columbus, Fielder, Glenlea, HY320, Katepwa, Leader, Macoun, Neepawa, Selkirk. ***Triticale:*** Carman, Welsh. ***Winter Wheat:*** Norstar, Sundance. ***Forages Underseeded to Wheat or Barley:*** Alfalfa, bird's-foot trefoil, bromegrass, clover (red, sweet), crested wheatgrass, fescue (creeping red, red, meadow), Kentucky bluegrass, orchard grass, reed canary grass, Russian wildrye grass, timothy.
4. WEEDS CONTROLLED: Wild oats (7.5)
5. WEEDS SUPPRESSED: None
6. WHEN USED: Treat at 3-4 leaf stage to minimize early wild oat competition, and 4-5 leaf stage for better control. Do not apply to barley, wheat or canary seed after 6 leaf stage of crop. Do not use Avenge+Glean mix in the brown soil zone and use no surfactant with the mixture.
7. HOW TO APPLY:
   With: Aircraft or ground equipment. Do not apply Avenge/Glean mix by air.
   Rate:

	Ground Application		Aerial Application	
	200C	**640**	**200C**	**640**
More than 200 wild oat plants/m²	1.7 L/ac	525 g/ac + 600 mL/ac. Agral 90/AgSurf.	1.7 L/ac	525 g/ac+120-300 mL/ac. Agral 90/AgSurf.
Less than 200 wild oat plants/m²	1.4 L/ac	445 g/ac + 600 mL/ac. Agral 90/AgSurf.	1.4 L/ac	445 g/ac+120-300 mL/ac. Agral 90/AgSurf.

   For registered mixes use the recommended rate of Avenge and the label recommended rate of other herbicide. Use up to 0.45 L/ac of MCPA ester or 2,4-D ester 500 and 1.4 or 1.7 L/ac of Avenge.
   Water Volume: ***Avenge 200C:*** Aircraft - Minimum 8 L/ac; Ground - 40 L/ac; Spra-Coupe - 40 L/ac. ***Avenge 640:*** Aircraft - 8-20 L/ac; Ground - 40 L/ac.
   Incorporation: Not applicable
   Pressure: 275 kPa
8. SPRAYING TIPS: (a) Nozzle should be tilted 45° forward for better spray penetration. (b) If foaming is a problem use a silicone-based anti-foam agent. (c) No restriction on following pesticide applications. (d) Do not spray if crop heavy with dew. (e) Use 50 mesh metal screens and filters when applying Avenge. (f) When using Glean mix, follow Glean label.
9. HOW IT WORKS: This chemical acts on the growing point located at or just above the soil surface and placing herbicide at or below this point is most efficient. It distrupts cell division and elongation causing growth to stop. Works best at high temperature and humidity.
10. EXPECTED RESULTS: ***Wild Oats:*** Start to yellow within 3-5 days after application. Effect will be faster when temperature and humidity are high. Affected plants will turn brown or remain stunted and partially green throughout the season. Wild oats in the 1-2 leaf stage at spraying or those that emerge after spraying will be unaffected. ***Crop:*** A slight yellowing of the crop may be visible 5-7 days after application and will remain visible for 2 weeks. ***Poor results may be expected if:*** Spraying before 3 leaf stage; too low a rate of Avenge for the wild oat population; inadequate coverage due to dense broad-leafed weed population; drought or temperature stress.
11. EFFECTS OF RAINFALL: Rainfall within 6 hours will seriously decrease activity.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Only oats can be seriously affected by drift. ***Grazing Restrictions:*** Do not graze or feed crop for 8 weeks after treatment. Treated underseeded forages should not be grazed or harvested for feed during the year of seeding. ***Crop Use After Hail:*** Do not use for 8 weeks after treatment.
14. TOXICITY: High acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (270). Non-toxic to fish, birds or bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles to prevent contact with skin and eyes. ***Symptoms of poisoning:*** headaches, tiredness and diarrhea. No long term health problems noted.
    First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical aid in all cases.
16. STORAGE: All Avenge 200C now in circulation (since and including 1983 production) will withstand freezing temperatures, returning to full solution as temperature warms.

BANVEL (dicamba)

Velsicol

CAUTION POISON

1. FORMULATIONS: Solution 400 g/L, 10 L. Solution 480 g/L, 9.5 L. **The 480 g/L formulation is being introduced in 1986. Please know which formulation you have before using the rates outlined in "How to Apply".**

2. REGISTERED MIXES: Banvel+2,4-D (amine or L.V. ester). Banvel+MCPA amine. Banvel+MCPA K. Banvel+Sencor or Lexone (metribuzin). Banvel+Roundup.

3. CROPS:

barley (8.2)	grass, canary	oats (8.6)	reduced tillage
corn, field	grasses (established turf,	rye, spring	noncrop areas
fescue, red (seed crops)	pasture, rangeland)	wheat (durum, spring, winter)(8.2)	(stubble, summerfallow)

4. WEEDS CONTROLLED:

Banvel Alone*	**Banvel+Roundup**		**Banvel+2,4-D**
buckwheat	(Reduced Tillage)	lady's-thumb	(Brush)
(Tartary(6.7), wild(7.9))	buckwheat, wild**	lamb's-quarters	alder
cleavers**(6.4)	cereals, volunteer	mustard, wild	aspen poplar
cow cockle (7.0)	cow cockle	oats, wild	cherry
lady's-thumb (6.4)	flixweed**	rapeseed, volunteer	rose, wild
smartweed, green (6.5)	foxtail, green	stinkweed	snowberry, western
spurry, corn (6.0)	kochia	thistle, Russian	willow, wolf

* Registered tank mixes will control these weeds plus weeds controlled by the other herbicide in the mix.
** Suppression or control dependent on rates used.

5. WEEDS SUPPRESSED: Banvel will control top growth of Canada thistle, and perennial sow-thistle at in-crop rates. Banvel+Roundup mix will suppress red root pigweed, and foxtail barley.

6. WHEN USED:

(a) Timing of Application

	Recommended Leaf Stage or Height of Crop:				
Crop	**Banvel Alone**	**Banvel+2,4-D Amine-500**	**Banvel+MCPA Amine-500**	**Banvel+MCPA K-400**	**Banvel+ Metribuzin**
wheat (spring, durum)	2-5	2-5	2-5	2-5	2-4 (spring wheat only)
oats	2-5	-	2-5	2-5	-
barley	2-5	2-5	2-5	2-5	2-3
spring rye	2-3	2-3	-	-	-
wheat (winter)	15-25 cm	15-25 cm	15-25 cm	15-25 cm	
canary grass	3-5	-	3-5	-	-
corn (post emergence)	up to 20 cm	up to 10 cm			
(drop nozzles)	20-50 cm	10-50 cm			

(b) Other Uses

(1) ***Crop-free land (Canada thistle, perennial sow-thistle, field bindweed).*** (a) Summerfallow: Banvel alone, cultivate in spring. Apply before thistles reach early bud stage (15-25 cm tall); when field bindweed is flowering. Banvel+Roundup+non-ionic surfactant, for Canada thistle or perennial sow-thistle only. Tillage and timing practices same as above. (b) Stubble: Banvel alone or Banvel+Roundup+non-ionic surfactant, Apply to thistle regrowth when 10-15 cm tall. Apply 2 weeks prior to first killing frost.

(2) ***Reduced Tillage for annual weeds, summerfallow:*** apply Banvel+Roundup+non-ionic surfactant to actively growing weeds from 8-15 cm tall.

(3) ***Pastures, Rangeland Grasses:*** Apply when weeds are actively growing or when brush species are under 2 m tall.

(4) ***Red fescue:*** Apply when new seedling stands are 5.0 cm tall. In established stands, apply up to shot blade stage.

7. HOW TO APPLY:

With: Ground equipment. Air (Banvel or Banvel+phenoxy mixes only.) Use only 110 mL/ac (400 g/L) or 95 mL/ac (480 g/L) when applying Banvel by air.

Rate: See tables for 400 g/L and 480 g/L.

Water Volume: Wheat, oats, barley, spring rye, red fescue, canary grass - 45 L/ac. Corn - 90-140 L/ac. Summerfallow/stubble (thistles) 45-90 L/ac. Reduced Tillage 20-40 L/ac. Pastures and Rangeland grasses (see product rate table). Air - not less than 8 L/ac.

Pressure: 275 kPa; For air do not use nozzle pressure above 200 kPa.

BANVEL 400 g/L FORMULATION

Crop	Banvel Alone mL/ac	Banvel+2,4-D Amine-500 mL/ac+mL/ac	Banvel+MCPA Amine-500 mL/ac+mL/ac	Banvel+MCPA K-400 mL/ac+mL/ac	Banvel+Metribuzin (Sencor OR Lexone DF) ml/ac+mL/ac OR g/ac
wheat (spring, durum)	110-140	110-140+340	110-140+340	110-140+445	110+110-170 mL OR 110 g
oats	110-140	-	110-140+340	110-140+445	-
barley	110	110+340	110+340	110+445	110+110-170 mL OR 110 g
spring rye	110-140	110-140+340	-	-	-
wheat (winter)	110-140	110-140+340	110-140+340	110-140+445	-
canary grass	140	-	140+340	-	-
corn (field)	285	140+340	-	-	-
red fescue	285	285+600	-	-	-

Other Uses	Banvel Alone L/ac	Banvel+2,4-D Amine-500 rate/ac	Banvel+2,4-D L.V. Ester-600 rate/ac	Banvel+Roundup+ non-ionic surfactant mL/ac+mL/ac+mL/ac
summerfallow/ stubble - thistle (Canada, sow)	1.2 L	-	-	610+690+142
reduced tillage	-	-	-	140-280+305-400+142
Pastures and Rangeland Grasses				
weed control	1.0-2.2 L	1.0 L+0.9 L	1.0 L+0.75 L	-
brush control	-	2.5 L+4.0 L in 1000 L water	2.5 L+3.3 L in 1000 L water	-

BANVEL 480 g/L FORMULATION

Crop	Banvel Alone mL/ac	Banvel+2,4-D Amine-500 mL/ac+mL/ac	Banvel+MCPA Amine-500 mL/ac+mL/ac	Banvel+MCPA K-400 mL/ac+mL/ac	Banvel+Metribuzin (Sencor OR Lexone DF) ml/ac+mL/ac OR g/ac
wheat (spring, durum)	95-115	95-115+340	95-115+340	95-115+445	95+110-170 mL OR 110 g
oats	95-115	-	95-115+340	95-115+445	-
barley	95	95+340	95+340	95+445	95+110-170 mL OR 110 g
spring rye	95-115	95-115+340	-	-	-
wheat (winter)	95-115	95-115+340	95-115+340	95-115+445	-
canary grass	115	-	115+340	-	-
corn (field)	245	115+340	-	-	-
red fescue	245	245+600	-	-	-

Other Uses	Banvel Alone L/ac	Banvel+2,4-D Amine-500 rate/ac	Banvel+2,4-D L.V. Ester-600 rate/ac	Banvel+Roundup+ non-ionic surfactant mL/ac+mL/ac+mL/ac
summerfallow/ stubble - thistle (Canada, sow)	1.0 L	-	-	510+690+142
reduced tillage	-	-	-	115-245+305-400+142
Pastures and Rangeland Grasses				
weed control	0.85-1.9 L	0.85 L+0.90 L	0.85 L+0.75 L	-
brush control	-	2.1 L+4.0 L in 1000 L water	2.1 L+3.3 L in 1000 L water	-

Broadcast ground application of Banvel+2,4-D in 90-130 L/ac of water as follows:

Brush Species	400 g/L Formulation	480 g/L Formulation
Aspen Poplar	1.5 L/ac+1.7 L/ac 2,4-D Amine-500 OR 1.5 L/ac 2,4-D Ester-600.	1.3 L/ac+1.7 L/ac 2,4-D Amine-500 OR 1.5 L/ac 2,4-D Ester-600.
Wild Rose	1.7 L/ac+1.7 L/ac 2,4-D Amine-500 OR 1.5 L/ac 2,4-D Ester-600	1.5 L/ac+1.7 L/ac 2,4-D Amine-500 OR 1.5 L/ac 2,4-D Ester-600
Western Snowberry	1.7 L/ac+1.5 L/ac 2,4-D Ester-600	1.5 L/ac+1.5 L/ac 2,4-D Ester-600

8. SPRAYING TIPS:
   (a) Flat fan nozzles are more efficient than flooding tips.
   (b) Do not spray if rain is expected within 4 hours of application.
   (c) Best application is when crop is under good growing conditions and air temperature 10-25°C.
   (d) Avoid application if risk of frost or severe drop in night temperature is forecast.
   (e) Avoid application when crop is under stress from adverse environmental conditions.
   (f) Crop damage can occur if the chemical is applied at any time other than the recommended crop stage.

9. HOW IT WORKS: Absorbed through roots and leaves and translocated in phloem and xylem, disrupting the metabolism.

10. EXPECTED RESULTS: ***Weeds:*** Results may take 10-14 days to appear. Proliferation of tissues in plant causes: twisting, bending of main stem, leaf petioles; cupping of leaves; increase in root size; stimulation of fibrous root production. Better control of cleavers may be obtained by spraying them before the 3 whorl stage. ***Crops:*** Under certain growing conditions shortening of straw can occur in treated crops without having adverse affect on crop yield. If applied at other than recommended crop stage, head and stem deformities may occur. Crops under stress from excess moisture, drought, disease, etc. may suffer a further setback from Banvel. The crop injury that occurs may be offset by the weed control obtained. ***Poor results may be expected if:*** it rains within 4 hours of application, or when older weeds are sprayed, or if less than the recommended water volume is used.

11. EFFECTS OF RAINFALL: Rainfall more than 4 hours after application will not reduce effectiveness.

12. MOVEMENT IN SOIL: Not applicable.

13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Can harm ornamentals and other desirable trees or plants. ***Grazing Restrictions:*** Do not graze wheat, barley or spring rye prior to maturity. ***Corn:*** Do not graze cattle or harvest for silage until 7 days following treatment with Banvel alone or Banvel plus 2,4-D amine. ***Canary grass:*** Canary seed should only be used as bird seed. ***Succeeding Crops:*** No restrictions unless Banvel has been applied at 1.2 L/ac (400 g/L) or 1.0 L/ac (480 g/L) on fallow or stubble. Then grow only cereals or field corn the following year. If this application is made after September 1 or if soil is dry subsequent to application, crop injury may occur in the following spring. If a Banvel+Roundup treatment is used for thistle control then rapeseed as well as cereals or field corn can be grown the following year.
Grazing Restrictions for Beef cattle and other meat animals: If treated vegetation has been consumed by meat animals within 30 days of Banvel application, feed the animal with untreated diet for 30 days before slaughter. Meat animals may graze or feed on treated pasture 30 days after Banvel application without restrictions on slaughter.
Grazing and Hay Restrictions for Dairy Cattle:

Rate/acre (400 g/L Formulation)	Days Delay Between Treatment and Grazing or Cutting For Hay
Up to 600 mL Banvel	0
600 mL-1.1 L Banvel	7
1.1-2.2 L Banvel	14
2.2-4.4 L Banvel	30

14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = technical (1,700-2,900). May cause mild skin irritation and extreme eye irritation and swelling. Non-toxic to fish and birds.

15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to reduce exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.

16. STORAGE: If frozen, shake thoroughly before use. No activity is lost if completely resuspended.

BANVEL 10G (dicamba)

Velsicol

1. FORMULATIONS: Granular 10% - 11.34 kg pail.
2. REGISTERED MIXES: None
3. WHERE USED: Non-crop areas (summerfallow, stubble, pastures and other areas such as fence rows and roadways).
4. VEGETATION CONTROLLED:

alder	bindweed, field	pin cherry	willow
aspen poplar	birch	spruce	
balsam fir	elm	thistle, Canada	

5. WEEDS SUPPRESSED: Not applicable.
6. WHEN USED: ***Brush:*** Apply in spring or early summer to brush or tree species up to 2 m in height. ***Canada thistle, field bindweed:*** Apply when plants are actively growing
7. HOW TO APPLY:
   With: Granular, broadcast-type spreader or with gloved hands.
   Rate: ***Brush control:*** 20.4-28.1 kg/ac (Use higher rate on sandy or rocky soils or in areas of high rainfall). ***Canada thistle, field bindweed:*** 22.7 kg/ac.
8. SPRAYING TIPS:
   (a) Do not apply Banvel 10G under desirable trees or other desirable plants or where these roots might extend.
   (b) When used on summerfallow apply to weed patches following a spring cultivation. For stubble apply to regrowth after harvest and 2 weeks before a killing frost.
   (c) If application is made to stubble land it must be fallowed the following year unless possible carryover of chemical is not objectionable.
   (d) Applications on cultivated land cannot exceed 1.2 acres in any 1 field and the total treated areas are not to be in excess of 2.5% of the total acreage of the field.
9. HOW IT WORKS: Rainfall moves dicamba into the root zone for uptake. A disruption of the metabolic and growth activities occurs within the plant.
10. EXPECTED RESULTS: Injury to treated vegetation may not be apparent until the following year particularly if dry conditions are present. Effect on broadleaved weeds results in twisting and bending on the main stem, cupping of leaves, increase in root size and stimulation of fibrous root production. Spot treatment may temporarily stunt the growth of desirable grasses or crops planted in the treated area the following year.
11. EFFECTS OF RAINFALL: Rainfall following application of Banvel 10G is necessary to move it into the root zone for uptake by weeds and brush.
12. MOVEMENT IN SOIL: Downward movement in the soil is faster in sandy or rocky soils and in areas of heavy rainfall.
13. GRAZING AND CROPPING RESTRICTIONS: ***Dairy Cattle Grazing:*** Pasture and rangeland grasses may be grazed or harvested 60 days after treatment. ***Beef Cattle Grazing:*** No restrictions on grazing. Do not slaughter meat animals fed with treated forage or grazed on treated areas within 60 days after Banvel 10G application. ***Cropping Restrictions:*** In cultivated areas plant only spring wheat, barley or oats the following year. Yields of spring grains may be reduced in the first year of cropping.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = technical (1,700-2,900). May cause mild skin irritation and extreme eye irritation and swelling. Non-toxic to birds and fish.
15. PRECAUTIONS, FIRST AID: Avoid breathing dust. Wear standard protective clothing (see page 2) and gloves. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention. IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Store in a dry place. Freezing will not affect activity.

BASAGRAN (bentazon)
BASF

1. FORMULATION: Solution - 480 g/L - 10 L pack.
2. REGISTERED MIXES: None
3. CROPS:
   beans (dry (8.1), faba (8.6), snap (8.1)) corn (field, sweet)(8.8) flax (8.8) peas (canning(8.3), field (8.2))
   Underseeding: Not recommended.
4. WEEDS CONTROLLED:
   buttercup, cocklebur, chickweed, common (7.2), corn spurry (7.0), galinsoga, hairy; groundsel, common (8.5), lamb's-quarters (6.2), mustard, wild (8.4), nightshade, black (6.0); pigweed, redroot (6.8), purslane, ragweed, common, shepherd's-purse (7.3); smartweeds, annual (7.0), stinkweed (7.8), thistle (Canadian (4.7), Russian (7.9))
5. WEEDS SUPPRESSED: Field bindweed.
6. WHEN USED: The best timing is 18-28 days after planting. Soybeans, most dry and snap common beans, and corn are tolerant at all growth stages. Peas can be treated with Basagran only after 3 pairs of leaves (or 3 nodes) are present. Fababeans may be treated with Basagran when the crop has 2-4 leaves, or is at least 10 cm tall. Flax may be treated with Basagran when it is 5 cm or taller.
7. HOW TO APPLY:
   With: Ground or air.
   Rate: All crops 700-900 mL/ac. Add 810 mL/ac of Assist Oil Concentrate to increase performance. Do not use Assist on peas, use Cittowett Plus at 2.5 L/1000 L of spray solution.
   Water Volume: 80-160 L/ac - ground. 20-40 L/ac - air.
   Pressure: 275-400 kPa
   Nozzles: Do not use flood-jet nozzles.
8. SPRAYING TIPS: Best results when weeds young and actively growing. Reduce Assist rate to 400 mL/ac under hot humid conditions.
9. HOW IT WORKS: Contact herbicide which interferes with photosynthesis. In resistant plants, metabolized to a non-toxic material.
10. EXPECTED RESULTS: ***Weeds:*** Weeds turn yellow initially and then brown, usually within 2 weeks. ***Crops:*** Yellowing, bronzing, speckling, or burning occurs sometimes. The crop usually outgrows the condition within 10 days. ***Poor results may be expected:*** when weeds are beyond recommended growth stage; when spray coverage is poor; or under poor growing conditions.
11. EFFECTS OF RAINFALL: Rainfall within 6-8 hours of application may reduce activity.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Avoid drift on to susceptible crops such as rapeseed and mustard. ***Grazing Restrictions:*** Do not feed green plants to livestock. ***Succeeding Crops:*** No restrictions.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = technical (850). Slightly toxic to fish; non-toxic to birds and bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. See a doctor immediately.
16. STORAGE: Basagran should be stored in a heated place. However, freezing will not affect activity. If frozen, warm to room temperature and shake well.

BENAZOLIN (benazolin)
Ciba-Geigy

1. FORMULATIONS: Solution 330 g/L - 4 L containers.
2. REGISTERED MIXES: None.
3. CROPS: Rapeseed (7.9). Underseeding: Not recommended.
4. WEEDS CONTROLLED: Wild mustard (7.8)
5. WEEDS SUPPRESSED: Canada thistle (3.7)
6. WHEN USED: Rapeseed: 3-5 true leaf stage; wild mustard: 2-4 leaves.
7. HOW TO APPLY:
   With: Aircraft or ground equipment.
   Rate: 600-850 mL/ac
   Water Volume: 22-40 L/ac
   Pressure: 275 kPa
8. SPRAYING TIPS: Remove all traces of herbicides from sprayer before spraying rapeseed - this is **absolutely essential**.
9. HOW IT WORKS: Not known.
10. EXPECTED RESULTS: Kill or suppress wild mustard.
11. EFFECTS OF RAINFALL: Do not spray if rain is expected within 4 hours.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: Avoid drift. No restrictions on grazing crop use after hail, or succeeding crops.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (3,000). May irritate skin and eyes. Not toxic to birds; slightly toxic to fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). If irritation persists see a doctor. IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Heated storage is essential.

BLADEX NINE-T (cyanazine)
Ciba-Geigy

1. FORMULATIONS: Dry Flowable 90%.
2. REGISTERED MIXES: With atrazine, Dual Ciba Geigy 960E, Eradicane, and Sutan+.
3. CROPS: Corn (field and sweet) (9.0).
4. WEEDS CONTROLLED:

barnyard grass	knotweed	pigweed (prostrate (6.7),	shepherd's-purse
buckwheat, wild	kochia	redroot (6.2))	smartweeds, annual
foxtail (green, yellow)(6.8)	lamb's-quarters	purslane	stork's-bill
goosefoot, oak-leaved	mustard (wild, wormseed)	ragweed (common, false)	thistle, Russian

5. WEEDS SUPPRESSED: None.
6. WHEN USED: Pre-plant incorporation on dryland, or pre-emergent followed in 5-7 days with irrigation. **NOTE:** Bladex Nine-T may be also applied early post-emergent.
7. HOW TO APPLY:
   With: Ground equipment.
   Rate: Preplant incorporation - 0.9-1.1 kg/ac. Pre-emergent - 1.0-1.2 kg/ac. Early post-emergent - 1.0 kg/ac. Use lower rates for light textured soils and higher rates for heavier soils.
   Water Volume: 60-80 L/ac.
   Pressure: 200-300 kPa.
8. SPRAYING TIPS:
   (a) Do not use Bladex on soils with more than 70% sand or less than 1% organic matter.
   (b) For early post-emergent application: add 1 L Bio-Veg T. M. crop oil/100 mL spray solution. Do not apply beyond the 3 leaf stage of corn (approx. 7.5 cm). Do NOT mix with any oils or adjuvants, other than Bio-Veg T.M. crop oil.
   (c) A timely inter-row cultivation will control any seedling weeds which escape the treatment.
9. HOW IT WORKS: Active through root uptake, requires moisture to carry to root zone. Interferes with photosynthesis.
10. EXPECTED RESULTS: Weeds fail to emerge or die before reaching 2-3 leaf stage.
11. EFFECTS OF RAINFALL: Rainfall or irrigation required for activation. Heavy rainfall on very sandy soil may cause leaching and reduce effectiveness.
12. MOVEMENT IN SOIL: Negligible unless excess moisture on very sandy soil.
13. CROPPING AND GRAZING RESTRICTIONS: Where atrazine mix is used, corn should follow corn.
14. TOXICITY: Slightly high acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (334). Low toxicity to fish and birds.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical aid.
16. STORAGE: Not damaged by freezing. Store in a dry place.

BLADEX TTC (cyanazine)

Ciba-Geigy

1. FORMULATIONS: Liquid - 480 g/L, 10 L containers.
2. REGISTERED MIXES: With Poast. ***Mix Restrictions:*** with agitator running add Bladex TTC to 1/2 the required amount of water, add water, then Poast, then Assist Oil Concentrate, then the remaining water.
3. CROPS: Triazine tolerant canola.
4. WEEDS CONTROLLED:

buckwheat, wild	hemp-nettle	pigweed, redroot	rapeseed (volunteer,
chickweed	lady's-thumb	shepherd's-purse	non-triazine tolerant)
cleavers	lamb's-quarters	smartweed, green	
groundsel, common	mustard, wild	stinkweed	

5. WEEDS SUPPRESSED: None.
6. WHEN USED: When crop and weeds are in 1-4 leaf stage.
7. HOW TO APPLY:
   With: Ground equipment.
   Rate: Bladex TTC - 1.2 L/ac. Bladex TTC - 1.2 L/ac + Poast - 325-770 mL/ac.
   Water Volume: 40 L/ac
   Pressure: 275 kPa
   Nozzles: Flat fan, screens 50 mesh or larger. Do not use flood-jet or hollow cone nozzles.
8. SPRAYING TIPS:
   (a) Optimum weed control is achieved when weeds are small and actively growing; later applications will be less effective.
   (b) Tank mix with Poast.
9. HOW IT WORKS: Inhibits photosynthesis.
10. EFFECTS OF RAINFALL: Rainfall within 2 hours of application may reduce effectiveness.
11. MOVEMENT IN SOIL: Not applicable
12. CROPPING AND GRAZING RESTRICTIONS: No cropping restrictions.
13. TOXICITY: Slightly high acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (334). Low toxicity to fish and birds.
14. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical aid.
15. STORAGE: Not damaged by freezing. Store in a dry place.

BLAGAL (cyanazine + MCPA-K)

Ciba-Geigy

1. FORMULATIONS: Suspension - 125 g/L of cyanazine and 250 g/L MCPA-K. 2 - 10 L jugs/pack.
2. REGISTERED MIXES: None.
3. CROPS: Spring wheat (8.7), barley (8.5), oats (9.0), flax (8.1).
   Underseeding: Not recommended.
4. WEEDS CONTROLLED:

buckwheat	corn spurry (8.4)	mustard (ball, tumble, wild,	radish, wild
(Tartary (8.2), wild (7.2))	hemp-nettle (7.9)	wormseed)(8.7)	stinkweed (8.7)
chickweed (7.6)	lamb's-quarters (8.7)	pigweed, redroot (6.1)	MCPA-K susceptible weeds

5. WEEDS SUPPRESSED: Canada thistle, horsetail.
6. WHEN USED: Cereals, 2-5 leaf stage; flax, 5-10 cm high. Canada thistle, delay application until cereals have reached 5 leaf stage.
7. HOW TO APPLY:
   With: Ground equipment.
   Rate: 910 mL/ac
   Water Volume: At least 40 L/ac
   Nozzles: Do not use flooding tips. Flat fan, screens 50 mesh or larger.
   Pressure: 200-300 kPa.
8. SPRAYING TIPS:
   (a) Application after 5 leaf stage may cause serious crop injury and give poor weed control.
   (b) Vigorous agitation necessary if the solution stands for several hours before spraying.
   (c) Boom Angle: Direct spray straight down.
   (d) Allow 4 days before or after wild oat herbicide application.
9. HOW IT WORKS: Cyanazine and MCPA-K act synergistically to disrupt metabolism and inhibit photosynthesis.
10. EXPECTED RESULTS: ***Weeds:*** Yellow blotches first appear in 5-10 days then the whole plant turns yellow and brown and dies. Young vigorously growing plants affected first. ***Crop:*** Under moisture or temperature stress, Blagal may cause temporary yellowing of lower leaves.
    Poor results may be expected if: (a) Reduced application rate. (b) Poor penetration through dense crop canopy. (c) Extremely poor growing conditions (droughty). (d) Late application.
11. EFFECTS OF RAINFALL: Rain within 4 hours will seriously reduce activity.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: ***Grazing restrictions:*** Do not graze or feed green plants to livestock. ***Crop use after hail:*** Use if mature. ***Succeeding crops:*** No restrictions.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = Cyanazine (334), MCPA (700). Non-toxic to fish, birds and bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to avoid contact with skin or eyes. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Not damaged by freezing. Store in dry area and shake well before use. To re-suspend, warm and agitate.

BUCTRIL M (bromoxynil + MCPA)
May and Baker

1. FORMULATIONS: Emulsifiable concentrate - bromoxynil 280 g/L + MCPA 280 g/L; 8L.
2. REGISTERED MIXES: Asulox F, Atrazine, Avenge, MCPA Ester or amine, TCA (barley, oats), Poast + Assist
   Mix Restrictions:
   (a) With MCPA - with agitator running add Buctril M to 1/2 of the water then add rest of water and MCPA.
   (b) With Avenge - As above, adding Avenge last.
   (c) Add Asulox F or TCA to the prepared mix of Buctril M.
3. CROPS:
   barley (8.8)
   canary grass (8.5)
   corn (field, sweet)(9.0)
   flax (8.4)
   oats (8.8)
   rye, fall
   wheat, durum
   wheat, winter (fall or spring applied) (8.6) spring

   Underseeding: Not recommended

   seedling grasses (for seed)
   bromegrass (8.9)
   fescue (creeping red, meadow (8.3))
   orchard grass (8.9)
   Russian wild ryegrass (9.0)
   timothy (8.8)
   wheatgrass (8.5) (crested, intermediate, slender, tall)
4. WEEDS CONTROLLED:
   bluebur
   buckwheat
   (Tartary, wild (8.1)
   chamomile, scentless (7.6)
   cocklebur
   cow cockle (7.8)
   flixweed
   groundsel, common
   hemp-nettle*
   knawel
   kochia (6.7)
   lamb's-quarters (8.6)
   mustard (8.4)
   (ball, tumble, wild, wormseed)
   night-flowering catchfly
   pigweed, redroot (7.9)
   ragweed, common
   rapeseed, volunteer (8.7)
   shepherd's-purse
   smartweeds, annual (8.2)
   stinkweed (8.9)
   sunflower, volunteer
   thistle, Russian (7.4)

   * Tank mix with MCPA preferred.
5. WEEDS SUPPRESSED: Canada thistle and perennial sow-thistle.
6. WHEN USED: Cereals - 2 leaf to early flag leaf. Winter wheat, fall rye - 2-4 leaf stage in the fall - after growth begins in spring to early flag leaf. Canary seed - 3-5 leaf. Flax - 5-10 cm. Buctril M (only) - 4-6 leaf on corn and 2-4 leaf on seedling grasses. Weeds - before 5 leaf stage.
7. HOW TO APPLY:
   With: Ground equipment or air.
   Rate: Buctril M: 400 mL/ac.
   Water Volume: Ground Equipment: 20 or more L/ac. Air: 8 or more L/ac. Corn 80-120 L/ac.
   Pressure: 275 kPa
   Nozzles: No flood tips.
8. SPRAYING TIPS:
   (a) Avoid spraying during a severe drought. Under conditions of high temperature and humidity, slight discolouration of cereals may occur but no effect on crop yields.
   (b) Flax is less tolerant than cereals, therefore do not spray flax in hot humid weather when day time temperatures are over 25-29°C.
   (c) Best results are achieved when weeds are sprayed in seedling stage, with good spray coverage.
   (d) Corn: Buctril M at 400 mL/ac rate applied as an overall spray to corn in the 6 leaf stage. Buctril M at 400 mL/ac plus Atrazine at 450-910 g active/ac for broader spectrum weed control. Do not add oil or surfactant. Add Atrazine to the tank first. Observe precautions and limitations of both product labels. Cultivation after application is not recommended.
   (e) Seedling Grasses (not underseeded to legumes in the year of establishment). Buctril M at 400 mL/ac rate may be applied in the 2-4 leaf stage in 60 L/ac of water.
9. HOW IT WORKS: Bromoxynil is a contact type herbicide, therefore, good spray coverage is essential. Inhibits photosynthesis and plant respiration. MCPA is absorbed through leaves and is readily translocated in the plant.
10. EXPECTED RESULTS: Small burnt spots on the leaf can appear within hours, complete death takes up to 2 weeks. ***Poor results may be expected if:*** Poor coverage. Poor penetration through crop canopy.
11. EFFECTS OF RAINFALL: No effect.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: No grazing or crop use restrictions.
14. TOXICITY: High mammalian toxicity; oral LD_{50} rats (mg/kg) = (365). Very toxic to fish and birds; non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - Do NOT induce vomiting. Get medical attention.
16. STORAGE: Does not require heated storage.

CALMIX (bromacil + 2,4-D)
Union Carbide

1. FORMULATIONS: Pellets, Bromacil - 3% + 2,4-D 5% - 1 and 5 kg.
2. REGISTERED MIXES: None.
3. CROPS: Non-crop land only.
4. WEEDS CONTROLLED: Non-selective.
5. WEEDS SUPPRESSED: Not applicable
6. WHEN USED: Calmix may be used in any season.
7. HOW TO APPLY:
   With: Calmix spreader or shaker.
   Rate: 2.5 kg/100 m^2 - annual weeds and perennial seedlings. 3.75 kg/100 m^2 - shallow-rooted perennials. 5.0 kg/100 m^2 - heavy perennial growth.
   (a) Apply at the higher rate to heavier soils and/or to extend the growth control period.
   (b) For spot treatment apply 375 g to about 1 m^2. Repeat treatment when required.
   (c) For treatment around power poles, treat 1.25 m around each pole. Use about 250 g/pole.
8. SPRAYING TIPS:
   (a) Do not use near lawns or flower beds.
   (b) Do not apply closer than 1.5 times the height of nearby trees.
9. HOW IT WORKS: Systemic action, enters plant via roots.
10. EXPECTED RESULTS: Vegetation turns brown and dies. No new growth will appear, resulting in bare ground. Duration of control will depend upon amount of chemical applied, soil type and environmental conditions. ***Poor results may be expected if:*** Inadequate application rate. Soil erosion removes chemical from treated area when applied on slopes. Insufficient rainfall to activate chemical.
11. EFFECTS OF RAINFALL: Moisture will activate and carry the herbicide into the root zone.
12. MOVEMENT IN SOIL: Once fixed in the soil there is very little lateral movement. Pellets can be carried by erosion.
13. GRAZING AND CROPPING RESTRICTIONS: Not applicable.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = bromacil (5,200); 2,4-D (375). Slight toxicity to fish; non-toxic to birds.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to avoid exposure to dust. IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in dry area.

ERAMOX (atrazine + simazine)
Ciba-Geigy

1. FORMULATIONS: Wettable powder - 40% atrazine + 40% simazine - 25 kg packs
2. REGISTERED MIXES: None
3. CROPS: Total weed control and bare ground maintenance on non-crop land.
4. WEEDS CONTROLLED: Most growth. Milkweed and horsetail require more than 1 treatment.
5. WEEDS SUPPRESSED: Not applicable
6. WHEN USED: April and May OR August to freeze-up **NOTE:** Spring applications should be extended for a further month only if rainfall and soil moisture are plentiful, and top kill chemical is used.
7. HOW TO APPLY:
   With: Ground or small hand equipment.
   Rate: 5.75-11.5 kg/ac
   Water Volume:
   Incorporation: See "Soil Sterilants" page 4.
8. SPRAYING TIPS: See "Soil Sterilants" page 4.
9. HOW IT WORKS: Eramox is a formulation of 2 triazines that are taken up mainly by roots but may also be absorbed through foliage.
10. EXPECTED RESULTS: Weeds either do not emerge or die back soon after emergence.
11. EFFECTS OF RAINFALL: Average rainfall enhances performance. Very heavy rainfall on sandy soils can lead chemical from target area and a decrease in efficacy.
12. MOVEMENT IN SOIL: Low solubility, and low leachability, but there may be some physical movement on sloping ground.
13. GRAZING AND CROPPING RESTRICTIONS: Not applicable.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = 80W atrazine (3,000), 80W simazine (5,000). May cause dermatitis after prolonged exposure. Non-toxic to fish and birds, but it may be toxic to bees.
15. PRECAUTIONS, FIRST AID: Do not spray on foraging bees. Wear standard protective clothing (see page 2) to prevent exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Store in dry area, heating not required.

ESTAPROP (2,4-D + dichlorprop)
May and Baker

1. FORMULATIONS: Emulsifiable concentrate - 2,4-D - 282 g/L + dichlorprop - 300 g/L - 8 L.
2. REGISTERED MIXES: With Avenge.
3. CROPS: Spring wheat (8.2), winter wheat (9.0), barley (8.1). Underseeding - to legumes not recommended.
4. WEEDS CONTROLLED:
   bluebur (9.0)
   buckwheat
   (Tartary, wild (7.4))
   catchfly, night-flowering
   cocklebur
   flixweed
   goosefoot, oak-leaved
   kochia (7.5)
   lamb's-quarters (7.8)
   mallow, round-leaved
   mustard (ball, dog, wild, Indian, tumble, hare's ear, wormseed)(8.6)
   pigweed, redroot
   pigweed, Russian
   ragweed
   rapeseed, volunteer
   shepherd's-purse
   smartweeds, annual (7.8)
   sow-thistle, annual
   sunflower, volunteer
   stinkweed (9.0)
   stork's bill (6.9)
   thistle, Russian
5. WEEDS SUPPRESSED: Canada thistle (5.6), curled dock, perennial sow-thistle.
6. WHEN USED: Spring seeded crops - 4 leaf to flagleaf. Fall seeded crops - full tillering to flag leaf, applied in the spring. Early spraying of stork's bill, round leaved mallow and kochia gives good control.
7. HOW TO APPLY:
   With: Ground or air.
   Rate: 710 mL/ac
   Water Volume: 20-80 L/ac
   Pressure: 275 kPa
8. SPRAYING TIPS: None specified.
9. HOW IT WORKS: A systemic herbicide absorbed by leaf and stem.
10. EXPECTED RESULTS: Twisting and curling of weeds will commence 2-10 days after application. Growth ceases, eventually plants turn brown and die. ***Poor results may be expected if:*** (a) Poor coverage. (b) Low relative humidity during and after spraying.
11. EFFECTS OF RAINFALL: No information available.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: Drift over susceptible crops will cause injury. No grazing until 14 days after application.
14. TOXICITY: Contains no harmful dioxin. Slightly high acute mammalian toxicity; oral LD_{50} mice (mg/kg) = (400). May be toxic to bees.
15. PRECAUTIONS, FIRST AID: Do not spray on foraging bees. Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attentions.
16. STORAGE: May be stored at any temperature. Shake well after storing for 1 year or longer.

CARBYNE 2EC (barban)

Velsicol

1. FORMULATIONS: 240 g/L emulsifiable concentrate, 19 L container

2. REGISTERED MIXES: Carbyne 2EC + Avenge 200C (barley, spring and durum wheat).

3. CROPS:

alfalfa (8.7)	fababeans (8.7)	sugar beets (9.0)	***Seedling for Seed***
barley (8.8)	flax (7.7)	sunflowers (8.6)	fescue, creeping red (8.9)
bromegrass, smooth (8.2)	lentils (8.4)	wheat, durum	timothy (8.3)
canola (8.9)	mustard (8.9)	spring (8.9)	wheatgrass, crested (8.6)
clover (alsike (8.9),	peas (field, processing (8.8))		
red (9.0), sweet (6.0))	ryegrass, Russian wild (8.1)		

4. WEEDS CONTROLLED: Wild oats (6.6)

5. WHEN USED:

Crop:	**Stage:**
Wheat (spring, durum), barley lentils	Before the 4-leaf stage or the 14th day after emergence whichever is first.
Canola, sugar beets, fababeans sunflowers, mustard	When the wild oats are in the 2-leaf stage.
Flax	After the 2 leaf stage but prior to the 12-leaf stage or before 14 days after emergence.
Peas	Before the 6-leaf stage.
Forages, legumes, grasses	Before the 4-leaf stage.
Weed:	
Wild oats	When majority are in 2-leaf stage. Carbyne + Avenge: 3-4 leaf stage.

6. HOW TO APPLY:
With: Ground or Aircraft. Do no apply Carbyne + Avenge mix by air.
Rate: 600-700 mL/ac on all crops. Use higher rate when the wild oat density is 50 plants/m^2 or more, or when wild oats are not actively growing, or when wild oats have been injured by frost or wind. Carbyne + Avenge 200C Mix 340 mL/ac, 800 mL/ac.
Water Volume: ***Ground:*** 18 L/ac; ***Aircraft:*** 10-18 L/ac; ***Carbyne + Avenge Mix:*** (Ground only) 25-30 L/ac
Pressure: 300 kPa (minimum)
Nozzles: Tee Jet 650067, 730067, 800067; Delavan LF.67-65, LF.77-73, LF.67-80 Spray Jet 65.067, TK.75 or D.75.

7. SPRAYING TIPS:
(a) Wild oats seedlings will produce a new leaf every 5 days and under good growing conditions reach the 2-leaf stage 4-9 days after emergence. The degree of control is dependent upon the uniformity of emergence of the wild oats.
(b) There are no restrictions on applications of other pesticides after the Carbyne treatment; for the Carbyne + Avenge mix allow a 4 day interval between the application of this mix and the use of esters of bromoxynil, 2,4-D or MCPA.
(c) Do not apply when the crop is wet with dew or rain.
(d) Crop damage may occur if sprayed within 24 hours of frost.

8. HOW IT WORKS: A partially systemic herbicide: penetrates the leaf and stem surfaces of the wild oat plant, interfering with cell division.

9. EXPECTED RESULTS: Wild oat growth stops and leaves turn blue-green within 7-10 days. A swelling of the stem at ground level may occur. Leaf tips turn brown, the plant becomes brittle, dying 3-4 weeks after treatment.

10. EFFECT OF RAINFALL: Rainfall within 15 minutes after application may decrease control.

11. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** The hazard is low, however, common oats, buckwheat and rye can be seriously affected. ***Grazing Restrictions:*** Do not graze or feed crop for 5 weeks after treatment.

12. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (2,750). **Long-term exposure to this product has sensitized some people to it.** Very toxic to fish.

13. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - Do NOT induce vomiting. Get medical attention.

14. STORAGE: May be stored at freezing temperatures but must be returned to its original state by warming to room temperature and agitating thoroughly.

CASORON (dichlobenil)

Pfizer

1. FORMULATIONS: Granular - 4% - 15 kg pack; 2.25 kg shaker jug.
2. REGISTERED MIXES: None
3. CROPS:

ash	cedar, white	fruit trees	non-cropland
birch, cutleaf weeping	crabapple	honeysuckle	raspberries
caragana shelterbelts		juniper	willow
		maple	

4. WEEDS CONTROLLED:

bindweed	groundsel	mustard	shepherd's-purse
bluegrass, annual	horsetail	pigweed	smartweed
chickweed	knotweed	purslane	thistles
foxtail	lamb's-quarters	quackgrass	

5. WEEDS SUPPRESSED: None.
6. WHEN USED: Apply on crops established for at least 1 season if perennial weed rates are used. Allow 4 weeks after transplanting tolerant crops for non-perennial rates.
7. HOW TO APPLY:
   With: Ground granular applicator.
   Rate: 45-70 kg/ac - based on area actually treated. 91-223 kg/ac - perennial weed control. Apply in late fall but before soil freeze-up or early spring. Do not use on light soil with less than 2% organic matter.
8. SPRAYING TIPS: Not appliable.
9. HOW IT WORKS: Snow melt or rain moves Casoron into the soil. Casoron inhibits germination but acts primarily on growing points and root tips.
10. EXPECTED RESULTS: Growth of emerging shoots of some perennials controlled. Tolerant crops are unaffected if roots do not come in contact with Casoron in the upper layers of the soil.
11. EFFECTS OF RAINFALL: If it is dry, poor results can be expected.
12. MOVEMENT IN SOIL: Some movement in coarse-textured soils.
13. GRAZING AND CROPPING RESTRICTIONS: Do not transplant into treated soil for 1 year.
14. TOXICITY: Very low mammalian toxicity; oral LD_{50} rats (mg/kg) = (3,160). Slightly toxic to fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to avoid skin and eye contact. IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Dry storage - not affected by frost.

CO-OP GRANULAR SOIL STERILANT

Federated Co-operatives

1. FORMULATIONS: Dry granule - Sodium Metaborate Tetrahydrate 66.5%, Sodium Chlorate 30%; Diuron 1.25% - 1, 4 and 22.7 kg packs.
2. REGISTERED MIXES: None
3. CROPS: Use where long term, total vegetation control is desired.
4. WEEDS CONTROLLED: All growth.
5. WEEDS SUPPRESSED: Not applicable.
6. WHEN USED: Use in early spring when weeds are small or in fall when weeds are dormant.
7. HOW TO APPLY:
   With: Shaker can, mechanical spreader or knapsack sprayer.
   Rate: ***Annual weeds:*** 0.5-1 kg/10 m^2 - for dry application apply when rain is expected or water in. ***Persistent perennial weeds:*** 1-2 kg/10 m^2 - either at maturity of weed or on damp soil in spring. Use higher rates on deep rooted perennials.
8. SPRAYING TIPS:
   Limitations
   (a) Do not apply in hot, dry weather.
   (b) To avoid fire hazard from dead and dry vegetation, treat when weeds are small. If growth is well advanced, mow and rake before treatment. Do not apply on or near desirable plants or on areas into which their roots may extend, or in locations where the chemical may be washed or moved into contact with their roots.
   (c) Dried chemical residue on organic matter can be explosive.
   (d) Spray solution will damage leather.
9. HOW IT WORKS: Kills through contact action. Persists in the soil and provides prolonged control of germinating seedlings and re-growth from perennial roots. Length of control depends on: species, rate, soil type, rainfall, vegetation cover, and time of application.
10. EXPECTED RESULTS: Seedlings are controlled quickly. Slower kill on perennial weeds.
11. EFFECTS OF RAINFALL: Rainfall will move the chemical into the soil and enhance its activity; in areas of high rainfall or sandy soils, the residual effect is reduced due to leaching.
12. MOVEMENT IN SOIL: Limited.
13. GRAZING AND CROPPING RESTRICTIONS: Treated area will be rendered more or less unproductive for 1 or more years.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (2,300-3,500). May cause irritation of eyes, nose, throat and skin.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Store in cool, dry place. Avoid direct contact with ground or concrete floors when storing.

DESORMONE 7. DIPHENOPROP 700, SILVAPROP 700 (2,4-D + dichlorprop)

Union Carbide Pfizer May and Baker

1. FORMULATION: Emulsifiable concentrate - 2,4-D - 350 g/L + 2,4-DP - 350 g/L.
2. REGISTERED MIXES: None
3. CROPS: Non crop land, industrial areas, rights of way, roadsides.
   Underseeding - Not applicable.
4. WEEDS CONTROLLED:

Brush

alder
aspen
birch
buckbrush
elderberry
honeysuckle
poplar
sumac
wild cherry
willow

Weeds

burdock
Canada thistle
curled dock
perennial sow-thistle
tansy
toadflax
annual broadleaf weeds

5. WEEDS SUPPRESSED: None.
6. WHEN USED: Throughout growing season.
7. HOW TO APPLY:
   With: Power equipment, knapsack sprayer, aircraft.
   Rate: 8.5-11.0 L in 1000 L of water for foliage stem treatment. Weeds: 80-200 L/ac.
   Water Volume: Spray to point of run-off. For fixed wing application - not less than 8 L/ac - water may be replaced by oil.
   Pressure: As recommended for equipment used.
8. SPRAYING TIPS:
   (a) With agitator running, add herbicide to 1/2 carrier then add rest of carrier.
   (b) If used in oil, do not let water get in mixture.
   (c) Forms an emulsion in water - agitate to prevent separation.
9. HOW IT WORKS: A translocated, systemic herbicide absorbed by leaves.
10. EXPECTED RESULTS: Leaves brown and wilt shortly after spraying - no leaves appear the following year.
11. EFFECTS OF RAINFALL: Rain within 3 or 4 hours after application may reduce control.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: - no grazing restrictions. ***Drift*** over susceptible crops causes injury.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = 2,4-D (375); dichlorprop (875). 2,4-D present contains no dioxin.
15. PRECAUTIONS, FIRST AID: Do not apply when bees are foraging. Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: If frozen, warm to 5°C and mix well.

DUAL CIBA-GEIGY 960E (metolachlor)

Ciba-Geigy

1. FORMULATIONS: Emulsifiable concentrate - 960 g/L - 2 X 10 L pack, 1 X 110 L.
2. REGISTERED MIXES: May be applied as split application or tank mixed as follows. With Aatrex Liquid, Aatrex Nine-O, Bladex formulations, or Banvel. Kil-Mor and Estemine 2,4-D: split application only. Liquid nitrogen - 28% nitrogen solutions or complete liquid fertilizers may replace all or part of the water for pre-plant incorporated or pre-emergent application of Dual tank mixes in corn. Dry Bulk Granular Fertilizers - impregnate on fertilizer, soil apply, then incorporate to 5 cm.
3. CROPS: All corn and white beans.
4. WEEDS CONTROLLED: Barnyard grass, green and yellow foxtail plus weeds controlled by the second material in mix or oversprayed.
5. WEEDS SUPPRESSED: None.
6. WHEN USED: Pre-plant incorporated (PPI). Pre-emergent (PRE) under irrigation only.
7. HOW TO APPLY:
   With: Ground equipment - band or overall spray.
   Rate: Corn, white beans - 0.8-1.1 L/ac
   Corn - Tank mixes of Dual Ciba-Geigy 960E at above rate.

	Tank Mixes (Qty/ac)		
Weeds Controlled	**ppi***	**pre****	**Split Application post*****
Annual grasses and broad-leaf weeds	+0.5-0.7 kg/ac Aatrex Nine-0 or 0.9-1.3 L/ac Aatrex Liquid or 0.9-1.1 kg/ac Bladex Nine-T	+0.5-0.7 kg/ha Aatrex Nine-0 or 0.9-1.3 L/ac Aatrex Liquid or 0.8-1.0 kg/ac Bladex Nine-T	+345-445 mL/ac Kilmor or 285-445 mL/ac Estemine 2,4-D

** pre-plant incorporated; ** pre-emergence (under irrigation only); *** post emergence*

Water Volume: 70-140 L/ac

Incorporation: Incorporate to 5 cm. Do not exceed this depth since product dilution can occur. If using tandem discs set to cut to a depth of 10 cm operated at 6-9 km/h. If using vibrating shank cultivators with overlapping sweeps, set 10 cm deep and operate at 10-13 km/h. Spike tooth or diamond tooth harrows are good incorporation equipment. Immediate incorporation is not necessary although desirable.

Pressure: 200-300 kPa

8. SPRAYING TIPS:
   (a) Do not tank mix with Kil-Mor or Estemine.
   (b) For band treatments, use a press wheel ahead of the nozzle to level the band.
   (c) Do not impregnate on nitrate fertilizers (ammonium, potassium, sodium, calcium) or on single superphosphate (0-26-0), triple superphosphate (0-46-0) or on ammonium phosphate or on limestone. Fertilizer blends containing limestone may be impregnated.
9. HOW IT WORKS: Inhibits germination, particularly grasses.
10. EXPECTED RESULTS: Annual grasses do not germinate or under dry conditions may die back soon after emergence.
11. EFFECTS OF RAINFALL: Moisture required to move chemical to area of germination but an excess may move it below this area.
12. MOVEMENT IN SOIL: Some movement may occur if excess moisture or light soil.
13. CROPPING AND GRAZING RESTRICTIONS: Do not apply on muck, peat or high organic soils, or after growth has begun. Winter cereals may be seeded 4.5 months after treatment.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (2,780). Prolonged exposure may cause eye injury. Slightly toxic to birds; non-toxic to fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.

DYCLEER (dicamba)

Velsicol

WARNING POISON

1. FORMULATIONS: DyCleer - 400 g/L dicamba DMA, 10 L; 480 g/L dicamba DMA, 9.5 L. DyCleer 24 - 200 g/L dicamba DMA + 400 g/L 2,4-D amine, 10 L.
   The 480 g/L formulation is being introduced in 1986. Rates shown below refer ONLY to 480 g/L formulation.
2. REGISTERED MIXES: DyCleer + 2,4-D (amine or L.V. ester) Mixing with other pesticides: Not recommended.
3. REGISTERED USES: Non-cropland use for control of broad-leaf weeds and brush.
4. VEGETATION CONTROLLED: Deciduous, coniferous brush species; hard to kill annual and perennial weed species.
5. WHEN USED: ***Deciduous species:*** when leaves are fully expanded in June. ***Coniferous species:*** apply in June. ***Broad-leaf weeds:*** when actively growing, normally between May and July.
6. HOW TO APPLY:
   With: Conventional boom sprayer, a handgun or boomless type sprayer. Thorough coverage essential.
   Rate: 480 g/L formulation
   Brush:
   (a) Snowberry, wolf willow, aspen poplar, alder, wild rose: 2.1 L DyCleer plus 4 L of 2,4-D amine or L.V. ester 500 in 1000 L water, or 5.0 L DyCleer 24 in 1000 L water.
   (b) Balsam poplar, birch, black cottonwood, spruce, pine, balsam fir, tamarack: 4.0 L DyCleer + 8 L of 2,4-D amine or L.V. ester 500 in 1000 L water or 10 L DyCleer 24 in 1000 L water.
   Weeds:
   (a) Top growth of absinthe, Canada thistle, perennial sow thistle, leafy spurge, poverty weed, scentless Mayweed: 0.5 L/ac DyCleer or 1.1 L/ac DyCleer 24.
   (b) Perennial sow-thistle, ragweed, goldenrod, tansy ragwort, Canada thistle, field bindweed, and top growth of curled dock: 0.93 L/ac DyCleer or 2.2 L/ac DyCleer 24.
   (c) Diffuse knapweed, goat's-beard, ground cherry, pasture sage, poverty weed: 1.9 L/ac DyCleer or 4.5 L/ac DyCleer 24.
   (d) Baby's breath, fringed sage brush, and top growth control of cinquefoil and Russian knapweed: 3.7 L/ac DyCleer.
   (e) For control of a broader range of weeds, the recommended rate of DyCleer may be tank mixed with 2,4-D Amine or Ester.
   Turf:
   Clover, mouse-eared chickweed, erect knotweed: 0.5 L/ac DyCleer. For control of a broader range of weeds tank mix 0.90 L/ac 2,4-D Amine 500 or 0.81 L/ac 2,4-D Ester 600.
   Water Volume: Apply only in water for deciduous and coniferous brush. Rate/1000 L of water applied to point of run-off. For broad-leaf weed control: 45-90 L/ac. For turf: 45 L/ac.
7. SPRAY TIPS:
   (a) Thorough coverage of weed and wetting brush to the point of run-off is essential for control.
   (b) Brush and trees over 2 m should be cut and regrowth sprayed.
   (c) Do not mix with oils.
   (d) A tank mix of DyCleer with 2,4-D L.V. Ester may improve brush control, especially under drought stress.
8. HOW IT WORKS: Dicamba is a systemic herbicide that is absorbed through roots or leaves and translocated in most plants. Disrupts the metabolic and growth activities in the plant.
9. EXPECTED RESULTS: Excellent control of brush can be expected within a year of application. Effect on broad-leaf weeds may be seen in 10-14 days resulting in twisting and bending of the main stem, cupping of leaves, increase in root size and stimulation of fibrous root production. ***Precautions that should be followed:*** (a) Avoid applications if temperatures exceed 30°C to reduce risk of vapour drift. (b) Avoid applications onto soil over the root systems of desirable trees and shrubs. (c) Thoroughly clean application equipment after use.
10. EFFECTS OF RAINFALL: Rainfall 4 hours after application will not reduce effectiveness.
11. MOVEMENT IN SOIL: Very little can leach downward.
12. GRAZING AND CROPPING RESTRICTIONS: Not applicable.
13. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = dicamba DMA salt (2,600). Low toxicity to fish; non-toxic to bees.
14. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to reduce exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
15. STORAGE: Freezing may cause crystalization but no activity is lost if completely resuspended.

DYVEL (dicamba + MCPA-K)

Velsicol

1. FORMULATIONS: Water soluble solution 84 g/L dicamba and 336 g/L MCPA potassium salt; 10 L containers.
2. REGISTERED MIXES: None
3. CROPS: Barley (8.6), oats (9.0), spring wheat (8.7), winter wheat. Underseeding: Legume underseeding not recommended.
4. WEEDS CONTROLLED:

buckwheat	flixweed	mustard (8.8)	ragweed (common, giant,
(Tartary, wild (7.1))	hemp-nettle (6.5)	(wild, ball, tumble, Indian,	false)
burdock	kochia	hare's ear, wormseed)	shepherd's-purse
corn spurry (5.6)	lady's thumb	pigweed (prostrate, redroot	smartweed, green (7.7)
cocklebur	lamb's-quarters (8.6)	(8.8), Russian)	stinkweed (8.4)
cow cockle		radish, wild	sunflower, volunteer
			thistle, Russian (7.0)

5. WEEDS SUPPRESSED: Canada thistle (6.8), sow-thistle, cleavers.
6. WHEN USED: 2-5 leaf stage for spring wheat, barley and oats. For winter wheat apply in spring when wheat is 15-25 cm tall or before shot blade stage. Best results will be obtained on hemp-nettle, corn spurry and cow cockle if application is made at the 2-3 leaf stage of the weeds.
7. HOW TO APPLY:
   With: Ground or air.
   Rate: 510 mL/ac
   Water Volume: Ground - 45 L/ac. Air - not less than 8 L/ac.
   Pressure: Ground - 275 kPa. Air - not above 200 kPa.
8. SPRAYING TIPS:
   (a) Do not spray if rain is expected within 4 hours of application.
   (b) Best under good growing conditions and air temperature 10-25°C.
   (c) Avoid application if frost or severe drop in night temperature is forecast.
   (d) Avoid application when crop is under stress from disease or adverse environmental conditions.
   (e) Crop damage can occur if the chemical is applied at any time other than the recommended crop stage.
   (f) Shortening of straw may occur without loss in yield.
9. HOW IT WORKS: DyVel is a systemic herbicide that is absorbed through the roots and leaves and translocated readily.
10. EXPECTED RESULTS: ***Weeds:*** Twisting, bending of main stem and leaf petioles, cupping of leaves or increase in root size occur within 10-14 days. ***Poor results may be expected if:*** it rains within 4 hours of application, or when older weeds are sprayed, or if less than recommended water volume is used.
11. EFFECTS OF RAINFALL: Rainfall 4 hours after application will not reduce effectiveness.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: Do not graze or harvest for livestock feed prior to crop maturity.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = dicamba (1,707-2,900), MCPA (700). Non-toxic to birds, fish and bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to cut down on exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). May cause some swelling to eyes. IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Protect from freezing but if frozen no activity is lost if completely resuspended.

2,4-D

Numerous manufacturers

1. FORMULATIONS: 2,4-D low volatile ester - 500, 600, 700 g/L; 2,4-D amine - 500 g/L. 10 L, 20 L containers. Driamine - 2,4-D 80% Soluble Granule
2. REGISTERED MIXES: 2,4-D + atrazine and related triazines, bromoxynil, dalapon, dicamba, picloram, sodium TCA; 2,4-D ester + Avenge 200C, Stampede 360 on spring and durum wheat. Some formulations can be mixed with liquid fertilizer (28-0-0)
3. CROPS: Asparagus, barley (9.0), corn, flax, grasses (seeded, established), grass pasture, rye, turf, wheat (spring) (8.7), wheat (winter) (9.0).
4. WEEDS CONTROLLED: **NOTE:** First rating amine; second rating ester.

		Hard to Kill Weeds:	***Top Growth Control:***
bluebur	pigweed (prostrate, Russian) (7.0)	bindweed (hedge)	bindweed (field)
burdock	plantain	dandelion	blue lettuce
cocklebur	prickly lettuce	docks	Canada thistle
clover, sweet	purslane	gumweed	field horsetail
flixweed (7.8)(7.8)	radish (wild)	hairy galinsoga	leafy spurge
goat's-beard	ragweeds	mustard, dog	pigweed, redroot
kochia (5.7)(6.8)	shepherd's-purse (8.6)(8.0)	oak-leaved goosefoot	sow-thistle, perennial
lamb's-quarters (7.7)(8.0)	sow-thistle (annual)		
mustard (8.0)(8.0)	stinkweed (8.1)(8.0)		
(except dog, green tansy)	sunflower, annual		
peppergrass (common)	vetch		

5. WEEDS SUPPRESSED: Peppergrass (field), pineapple weed, Russian thistle, wormwood (biennial).
6. WHEN USED: ***Wheat, Barley, Rye:*** 3 leaf to just before flag leaf. ***Flax (linseed) (Amine only):*** 5 cm to before bud stage. ***Corn (Amine only):*** Emergence to 15 cm tall. Use drop nozzles to keep spray off foliage. ***Grass pasture and turf:*** Seedling weeds. ***Asparagus (Amine only):*** Cultivate, then apply before first spears. Could repeat after harvest. ***Brome and fescue grown for seed (Amine only)*** not in seedling year, prior to shot blade and no more than 0.9 L/ac.
7. HOW TO APPLY:
   With: Aircraft or ground equipment
   Rate:

	FORMULATION AND CONCENTRATION (Qty/ac)			
Crop	**Amine 500**	**Ester 500**	**Ester 600**	**Ester 700**
Wheat	280-450 mL	280-710 mL	240-610 mL	160-510 mL
Barley, rye	510-730* mL	510-730* mL	510-730* mL	510-730* mL
Flax	280-450 mL	Not Recommended	-	-
Corn at emergence	220-450 mL	Not Recommended		
post-emergence	610 mL	Not Recommended		
Established grass	450-810 mL	610-710 mL	340-610 mL	-
Grass pasture, turf	610 mL-1.7 L	810 mL-1.4 L	610 mL-1.1 L	610 mL-1.0 L
Asparagus	1.4 L	Not Recommended	Not Recommended	Not Recommended

   For registered mixes of 2,4-D Ester 500 with Avenge 200C - use up to 450 mL/ac of 2,4-D Ester 500 with 1.4-1.7 L/ac of Avenge 200C. With Stampede 360 use on spring and durum wheat only, use 1100 mL/ac Stampede 360 + 320-490 mL/ac 2,4-D Ester 500 OR 1100 mL/ac Stampede 360 + 490 mL/ac 2,4-D amine 500.
   * **NOTE:** Higher rates can be used if weed infestation is high, but some crop injury may occur.
   Water Volume: Aircraft: minimum 8 L/ac. Ground: Wheat, barley, rye, oats, corn - 40 L/ac; Flax (linseed) - minimum 40 L/ac of water; Grass Pastures and Turf - 160 L/ac for thorough coverage.
   Pressure: 275 kPa
8. SPRAYING TIPS: Spray during warm weather when the weeds are young and growing actively. At high temperatures vapourization of more volatile esters may cause injury to susceptible plants.
9. HOW IT WORKS: This hormone type herbicide causes abnormal growth, and affects respiration, food reserves and cell division in broadleafed plants. Absorbed primarily by leaves and stems and translocated to the growing tips and roots.
10. EXPECTED RESULTS: Susceptible plants become malformed before they die.
11. EFFECTS OF RAINFALL: A rain free period of 2 hours for esters, 4 hours for amine and 6 hours for salts.
12. MOVEMENT IN SOIL: Leaching does not pose a problem.
13. GRAZING AND CROPPING RESTRICTIONS: Do not use on bent grasses or on freshly seeded turf.
14. TOXICITY: Moderate acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (300-1,000). Some formulations may cause skin irritation. Some formulations are toxic to fish and should not be introduced into aquatic environments.
15. PRECAUTIONS,FIRST AID: Wear standard protective clothing (see page 2) and goggles. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF AMINE FORMULATIONS SWALLOWED - induce vomiting (see page 3). IF ESTER FORMULATIONS SWALLOWED - do NOT induce vomiting. In all cases, get medical attention.
16. STORAGE: Do not freeze amine, if frozen warm to 4°C and mix thoroughly before using.

2,4-D (Industrial)
Dow

1. FORMULATIONS: Low volatile ester - 564 g/L in 20 L pails.
2. REGISTERED MIXES: Mixing restrictions: Diesel oil, No. 2 fuel oil, kerosene, or water can be used as a carrier. With agitator running add 1/3 of the carrier, add herbicide then the remainder of the carrier. When using oil carriers do not allow water to get into product or spray tank. (Oil mixes are very expensive, use may be limited to small areas during dormant season.)
3. CROPS: Industrial and forestry locations. To control unwanted vegetation.
4. WEEDS CONTROLLED: Alder, balsam, poplar, trembling aspen, birch, elm, cherry, hazelnut, sumac, Manitoba maple, willow, and common broadleaf weeds.
5. WEEDS SUPPRESSED: Canada thistle, field bindweed.
6. WHEN USED: ***Foliar treatment:*** after foliage is fully developed. ***Stump treatment:*** On freshly cut stump any time including winter. ***Basal Bark Treatment:*** Any time. Do not cut for 1 year after application.
7. HOW TO APPLY:
   With: Aircraft or ground equipment.
   Rates: ***Foliar treatment:*** 8 L in 1000 L of water, ***Stump treatment:*** 30 L in 1000 L of diesel fuel, ***Basal bark treatment:*** 20-30 L in 1000 L of diesel fuel.
   Aircraft: Apply above proportions in a minimum of 12 L/ac.
   Pressure: Ground - up to 1700 kPa. Aircraft - 235 kPa.
8. SPRAYING TIPS:
   (a) Spray during warm weather when weeds and brush are actively growing.
   (b) Continuous agitation is required for the oil-water mixture.
   (c) Do not apply by air in dead-calm conditions as the "cloud" of suspended droplets may drift when wind comes up.
9. HOW IT WORKS: Absorbed through leaves and bark in trees. A hormone type herbicide causing an abnormal growth.
10. EXPECTED RESULTS: Brown crisp leaves first appear then complete death.
11. EFFECTS OF RAINFALL: A rain free period of 4-6 hours.
12. MOVEMENT IN SOIL: Minimal soil movement. 30 day half-life.
13. GRAZING AND CROPPING RESTRICTIONS: Use only on established turf grasses except creeping grasses such as bentgrass. Avoid spray drift.
14. TOXICITY: High acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (300-1,000). Some formulations may cause skin irritation. Toxic to fish and should not be introduced into aquatic environments.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles to reduce exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting; see a doctor immediately.
16. STORAGE: Store away from fertilizers, seeds, insecticides, fungicides or other herbicides intended for use on 2,4-D sensitive crops. If frozen, bring to room temperature before using.

EMBUTOX 625, EMBUTOX, 2,4-D BUTYRIC 400, COBUTOX 400 (2,4-DB)

May and Baker | Pfizer | Interprovincial Co-op

1. FORMULATIONS: Emulsifiable concentrate 400 g/L, 4 and 20 L. Embutox - 8 L, Embutox 625 - 625 g/L - 8 L.
2. REGISTERED MIXES: Embutox + Asulox F (alfalfa only) Embutox + MCPA (sodium and K Salts); Cobutox 400 + MCPA amine; 2,4-D Butyric 400 + MCPA. ***Mix Restrictions:*** Add Embutox to the Asulox F already pre-mixed in the spray tank.
3. CROPS: Alfalfa (8.0), bird's-foot trefoil, white and alsike clovers (8.9), seedling stage of legumes only - spring wheat (8.8), barley (9.0), oats (8.2), field corn, pastures (9.0).
4. WEEDS CONTROLLED:

buckwheat, wild (5.7)	mustard (ball, wild*,	ragweed	stinkweed
cocklebur	wormseed) (5.8)	redroot pigweed	thistle, bull
curled dock (8.0)	narrow-leaved hawk's-beard*	shepherd's-purse	yellow rocket
lamb's-quarters (8.4)	oak-leaved goosefoot	smartweeds, annual (5.4)	
	plantain		

   * ***For better control use Embutox + MCPA or 2,4-D Butyric 400 + MCPA.***
5. WEEDS SUPPRESSED: Canada thistle, field bindweed, perennial sow-thistle, dandelion and horsetail.
6. WHEN USED: Weeds - 1-3 leaf (seedling) stage. Seedling alfalfa, bird's-foot trefoil - 1-4 trifoliate leaf. Seedling white, alsike clover - after the first trifoliate leaf. Cereals - 5th leaf to the early flag leaf. Field corn - after crop is 38 cm high but before the beginning of tasselling. Pastures - after cutting or grazing, and before regrowth is 7.5 cm high.
7. HOW TO APPLY:
   With: Ground equipment
   Rate: 1.0-1.7 L/ac. Embutox 625 - 0.7-1.1 L/ac.
   Water Volume: 60-80 L/ac
   Pressure: 275 kPa
8. SPRAYING TIPS:
   (a) Do not spray in drought conditions.
   (b) Damage to forage legumes (especially to established alfalfa) may occur and increase in severity the longer treatment is delayed beyond stage recommended.
   (c) Oats are sensitive if treated before the 5 leaf stage.
   (d) For control of narrow-leaved hawk's-beard*, with Cobutox 400 apply 3.5 L/ac to rosettes in the fall after legume growth has ceased. For better wild mustard control - tank mix Embutox or Cobutox 400 with MCPA salt/ac use on seedling alfalfa and bird's-foot trefoil - some crop stunting may occur.
9. HOW IT WORKS: Susceptible plants convert 2,4-DB to 2,4-D. Certain legumes do not convert it. 2,4-DB is translocated to actively growing parts.
10. EXPECTED RESULTS: Weeds should die within 2-3 weeks of treatment.
11. EFFECTS OF RAINFALL: Rainfall before the foliage has dried from the spraying may decrease activity.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: No grazing restrictions.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,960). Toxic to fish; non-toxic to birds and bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: If Embutox or Cobutox 400 freezes it can be reactivated by warming to 20-22°C and agitating thoroughly. Do not freeze 2,4-D Butyric 400. Embutox 625 does not require heated storage.

EPTAM (EPTC)
Chipman

CAUTION POISON

1. FORMULATIONS: Emulsifiable concentrate 800 g/L (Eptam 8-E), 20 L container. Granular (Eptam 10-G), 20 kg bag.
2. REGISTERED MIXES: Eptam 8-E + liquid fertilizer Eptam 8-E + granular fertilizer (except for nitrate based fertilizer) Eptam 8-E + Lexone or Sencor (Irish potatoes)
3. CROPS: Alfalfa (9.0), bird's foot trefoil, dry beans (7.6), snap beans (8.6), flax (7.5), Irish potatoes (9.0), sunflowers (7.9), turnips (rutabagas) (8.0), sugar beets (8.3). Underseeding: Not recommended.
4. WEEDS CONTROLLED:
   barley, volunteer (8.6)
   barnyard grass (8.6)
   bluegrass, annual (7.2)
   chickweed, common
   corn spurry (9.0)
   foxtail, green (7.7)
   foxtail, yellow (8.4)
   hairy nightshade (8.5)
   henbit
   lamb's-quarters (6.4)
   nutsedge, yellow
   oats (volunteer, wild (8.1))
   pigweed (prostrate, redroot (6.3), tumble)
   purslane
   quackgrass
   ryegrass (8.4)
   wheat, volunteer (6.9)
   witchgrass
5. WEEDS SUPPRESSED: None
6. WHEN USED: ***Alfalfa and Bird's-foot Trefoil (New Seedings)*** – Just prior to planting. Do not use if seeding a grain or grass nurse crop. ***Beans, Snap or Dry (including Red Kidney Beans)*** – Just prior to planting - Do not use on Adzuki beans, cow peas, soybeans, lima beans or other flat podded beans except Romano. ***Flax, Sunflower (Spring)*** – Just prior to planting. Do not apply in the spring on soils with less than 3% organic matter. ***Flax, Sunflower (Fall)*** – Just prior to freeze-up. The following spring, just prior to seeding, cultivate lightly to destroy any overwintering rosettes. ***Potatoes*** – Incorporate in the fall or spring, after drag-off, or just prior to the last cultivation. Eptam 8-E can also be metered into irrigation equipment (see label for exact and detailed instructions). Do not apply within 45 days of harvest. ***Turnips*** – Apply and incorporate 6-10 days prior to planting. **NOTE:** Fall application should not be used in areas where soil drifting is a hazard.
7. HOW TO APPLY:
   With: Ground equipment or irrigation water.
   Rate: ***Alfalfa and Bird's-foot Trefoil:*** 1.7 L/ac or 13.8 kg/ac of Eptam 10-G.
   Snap or Dry Beans: 1.7-2.2 L/ac or 13.8-18.2 kg/ac of Eptam 10-G. ***Flax:*** Spring Treatment - Light soil 1.4 L/ac or 11.3 kg/ac Eptam 10-G. - Heavy soil 1.7 L/ac or 13.8 kg/ac Eptam 10-G., Fall Treatment - Light soil 1.7 L/ac or 13.8 kg/ac Eptam 10-G. - Heavy soil 2.2 L/ac or 18.2 kg/ac Eptam 10-G.
   Special Instructions for Flax: Seed shallow, less than 3 cm, into a firm seedbed. Deep seeding reduces stands.
   Potatoes: Before Planting, Drag-off - 1.7-3.4 L/ac or 13.8-27 kg/ac Eptam 10-G. Post emergence - 1.7-2.2 L/ac or 13.8-18.2 kg/ac Eptam 10-G. Sprinkler Irrigation - 1.7-2.3 L/ac Fall Treatment - 2.3-3.4 L/ac ***Sunflowers:*** Spring 1.7 L/ac or 13.8 kg/ac Eptam 10-G. Fall - 1.7-2.2 L/ac or 13.8-18.2 kg/ac Eptam 10-G. ***Turnips:*** Sandy soil 1.3 L/ac or 9.1 kg/ac Eptam 10-G - Heavy soil 1.7 L/ac or 13.8 kg/ac Eptam 10-G
   Water Volume: 45 L/ac
   Incorporation: Eptam 8-E or 10-G should be incorporated immediately. If using power-driven cultivation equipment, set the implement to cut 5-7.5 cm deep. Tandem and One Way Discs - Set to cut 10-15 cm and operate at 6.5-9.5 km/h followed by harrows. Incorporation should be done twice in 2 different directions. Field Cultivators - for lighter soils in good tilth. Use 3-4 rows of sweeps spaced no wider than 18 cm. Cut 10-15 cm deep at 9.5 km/h. The second incorporation must be made at a right angle to the first. Harrows should be pulled behind the cultivator.
   Pressure: 275 kPa approximately 40 L/ac.
8. SPRAYING TIPS: When applying Eptam 8-E with granular fertilizer, a minimum of 81 kg/ac and a maximum of 324 kg/ac of fertilizer is required. See product label for further instructions.
9. HOW IT WORKS: Eptam is taken up by the roots and shoots of a germinating weed where it disrupts and stops further growth.
10. EXPECTED RESULTS: ***Weeds:*** Since Eptam is absorbed by the weed shoot, most affected weeds will not emerge. Numerous chlorotic and bleached shoots may be visible by removing the top few inches of treated soil. It should provide effective weed control for approximately 6-8 weeks. ***Crops:*** If crop seedlings are weak, some injury may occur.
11. EFFECTS OF RAINFALL: Very soluble in water so excessive moisture may cause leaching.
12. MOVEMENT IN SOIL: Eptam will move readily in the soil.
13. GRAZING AND CROPPING RESTRICTIONS: None. ***Crop Use After Hail:*** No restrictions. ***Succeeding Crops:*** No restrictions.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,600). Very toxic to fish; non-toxic to birds.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: Heated storage not required. Store away from seed and fertilizer.

ERADICANE 8-E (EPTC + R25788)
Chipman

CAUTION POISON

1. FORMULATIONS: Emulsifiable concentrate - 800 g/L, 20L.
2. REGISTERED MIXES: With Atrazine (80W or F), liquid fertilizer, granular fertilizer, urea and urea blends. Mix restrictions - check compatability.
3. CROPS: Corn (field, sweet) (9.0)
4. WEEDS CONTROLLED:
   barley, volunteer (7.0)
   barnyard grass (8.7)
   bluegrass, annual
   common chickweed
   corn spurry
   foxtail (green (8.4), yellow)
   henbit
   lamb's-quarters (9.0)
   nightshade, hairy
   oats (volunteer, wild) (8.1)
   pigweed (prostrate, redroot, tumble) (8.6)
   purslane
   quackgrass
   ryegrass, volunteer
   wheat, volunteer (9.0)
5. WEEDS SUPPRESSED: None.
6. WHEN USED: Apply and incorporate and seed corn as soon as possible.
7. HOW TO APPLY:
   With: Ground equipment
   Rate: Field and silage corn - 1.7-3.4 L/ac, Sweet corn - 1.7-2.2 L/ac (Annual weed control)
   Water Volume: 45 L/ac
   Incorporation: Within minutes of application. Use power-driven cultivation equipment, set to cut 5-7.5 cm deep or discs set 10-15 cm - both these types of equipment should operate at 6.5-9.5 km/h. A second working, at right angles to the first will provide adequate mixing.
   Pressure: 275 kPa
8. SPRAYING TIPS: Proper soil coverage and immediate and adequate soil mixing are important.
9. HOW IT WORKS: Absorbed by roots and shoots of a germinating weed, disrupts and stops growth and causes eventual death.
10. EXPECTED RESULTS: ***Weeds:*** Affected weeds do not emerge, chlorotic and bleached shoots are visible by removing a layer of treated soil. ***Crops:*** Weak seedlings may be injured. ***Poor results may be expected if:*** soils are wet, cloddy and trashy; not suitable for proper application or incorporation.
11. EFFECTS OF RAINFALL: Very soluble therefore, excessive moisture may cause leaching.
12. MOVEMENT IN SOIL: Will move readily.
13. GRAZING AND CROPPING RESTRICTIONS: No restrictions on grazing, crop use after hail nor on succeeding crops. Danger from drift is low. **Caution:** Excessive incorporation required may cause erosion on some soil.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,600).
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention immediately.
16. STORAGE: Heated storage not required.

KIL-MOR (2,4-D + mecoprop + dicamba)
Ciba-Geigy

CAUTION POISON

1. FORMULATIONS: Water soluble solution containing 295 g/L 2,4-D + 80 g/L mecoprop + 110 g/L dicamba; 10 L containers.
2. REGISTERED MIXES: Kil-Mor 345-445 mL/ac + Aatrex Liquid 2.25 L/ha or Aatrex Nine-0 1.25 kg/ha.
3. CROPS: Spring (including durum) and winter wheat (7.9), flax, oats (8.6), barley (8.5), sweet (7.3) and field corn (7.3). Underseeding: Not recommended
4. WEEDS CONTROLLED:
   In crops
   artichoke, Jerusalem (in corn)
   bindweed, hedge
   buckwheat, Tartary (7.9)
   buckwheat, wild (7.9)
   cocklebur
   cow cockle (7.6)
   flax
   flixweed (7.8)
   knotweed
   lady's-thumb
   lamb's-quarters (8.5)
   mustards (8.6)
   peppergrass
   pigweed (prostrate, redroot) (7.9)
   ragweed, common
   shepherd's-purse(8.6)
   smartweeds, annual (7.7)
   sow-thistle, annual
   spurry, corn (7.3)
   stinkweed (8.8)
   thistle, Russian (7.3)
   Along roadsides
   alders
   chicory
   cockle, white
   goat's-beard
   poison ivy
   ragwort
   sheep-laurel
   thistle, bull
5. WEEDS SUPPRESSED: Field bindweed, Canada thistle, cleavers, round-leaved mallow.
6. WHEN USED: ***Spring wheat:*** 3-5 leaf stage. ***Winter wheat:*** in spring before crop is 30 cm high ***Oats:*** 3-4 leaf stage ***Barley:*** 2-3 leaf stage ***Corn:*** Overall spray prior to 15 cm height of corn, use drop nozzles after 15 cm height ***Roadsides:*** Spring when weeds are in 2-5 leaf stage and growing actively. ***Flax:*** 10 cm high (no later).
7. HOW TO APPLY:
   With: Ground equipment
   Rate: Spring wheat, winter wheat, oats, sweet corn - 340-450 mL/ac. Roadsides - 1.3 L/ac.
   Summerfallow - 450-710 mL/ac
   Water Volume: 40 L/ac for cereals and flax, 80-140 L/ac for corn.
   Pressure: 275 kPa
8. SPRAYING TIPS: Barley is the most sensitive crop to Kil-Mor. Ensure that proper rate, water volume and timing is used, otherwise, crop injury may occur. Risk of crop injury increases as water volume drops below 36 L/ac.
9. HOW IT WORKS: Kil-Mor accummulates in the growing points resulting in abnormal growth which disrupts the transport system in plants.
10. EXPECTED RESULTS: ***Weeds:*** Visible effects occur 7-14 days after spraying. Leaves curl, leaf petioles twist, leaf edges turn brown, whole plant ceases growth and eventually turns brown and dies. ***Crop:*** Improper applications can result in abnormal bending at the internodes of grain stalks, difficulty in head emergence from sheath, curled awns, malformed kernels and sterile florets. ***Poor results may be expected if:*** Inadequate coverage. Rainfall less than 4 hours after application. Weeds overmature.
11. EFFECTS OF RAINFALL: Do not spray if rain is expected within 4 hours.
12. MOVEMENT IN SOIL: Not applicable
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Tomatoes, sugar beets, sunflowers, beans, turnips, cauliflower, cabbage, ornamentals and fruit crops are very sensitive to drift. ***Grazing Restrictions:*** None. ***Crop Use After Hail:*** No restrictions. ***Succeeding Crops:*** No restrictions,
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,028). **Mecoprop has potential to produce enlarged kidneys after long-term continuous exposure.** 2,4-D in formulation contains no dioxin. Non-toxic to fish; toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to reduce exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Heated storage only.

KRENITE (fosamine)
DuPont

1. FORMULATIONS: Solution - 480 g ammonium salt - 10 L pack.
2. REGISTERED MIXES: Krenite + a non-ionic surfactant.
3. CROPS: Brush control on non-crop land only.
4. WEEDS CONTROLLED: Alder, ash, aspen (trembling), birch, elm, pine and white spruce.
5. WEEDS SUPPRESSED: Not applicable
6. WHEN USED: From mid-June to end of July.
7. HOW TO APPLY:
   With: High volume. Ground equipment.
   Rate: Use 10.0-15.0 L/1,000 L of water and add 1-2 L of surfactant to the mixture. Use higher rate for white spruce.
   Water Volume: Apply 200-1,200 L of spray solution/ac to point of run-off.
8. SPRAYING TIPS: Do not apply to food crops. A non-ionic surfactant is required to control most conifers and to control the root suckering of deciduous brush.
9. HOW IT WORKS: Absorbed by leaves, stems and buds. Restricts bud development the following spring.
10. EXPECTED RESULTS: Injury may not be observed until the following spring, particularly if minimum rates are used or if cool temperatures prevail when spraying was done. Plants will fail to develop leaves and subsequently die.
11. EFFECTS OF RAINFALL: Rainfall within 24 hours of application may reduce effectiveness.
12. MOVEMENT IN SOIL: Little downward movement as Krenite readily adsorbs to soil colloids.
13. GRAZING AND CROPPING RESTRICTIONS: Do not graze on land treated with Krenite.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (20,000). Non-toxic to birds and fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Store in a cool dry place.

FUSILADE (fluazifop-butyl) *
Chipman

CAUTION POISON

1. FORMULATIONS: Emulsifiable concentrate - 250 g/L, 8 L.
2. REGISTERED MIXES: Fusilade + 2,4-DB; Fusilade + metribuzin (Lexone, Sencor)
3. CROPS:
   alfalfa*, bird's-foot trefoil, clover, red*, flax (8.4), potatoes, sugar beets (8.9), sunflowers (9.0)
   Do not graze or harvest for feed in year of treatment.
4. WEEDS CONTROLLED:
   barley (6.2), barnyard grass (7.5), corn, foxtail, green (7.0), foxtail, yellow, Johnson grass, millet, wild proso, Persian darnel (6.8), quackgrass (6.4), wheat (9.0), wild oats (7.5)
5. WEEDS SUPPRESSED: At lower rate, yellow and green foxtail.
6. WHEN USED: When weeds are actively growing; 2-4 leaf stage of green and yellow foxtail; 3-5 leaf stage quackgrass (season-long control); 2-6 leaf stage of other grassy weeds and corn (prior to tillering).
7. HOW TO APPLY:
   With: Ground equipment
   Rate: ***Corn:*** 250mL/ac. ***Barnyard grass, Johnson grass, Persian darnel, barley, wheat:*** 330 mL/ac ***Wild oats, wild proso millet*** 400 mL/ac ***Green and yellow foxtail suppression:*** 400 mL/ac - 570 mL/ac ***Quackgrass (tilled land):*** 810 mL/ac. ***(non-tilled land):*** 1.2-1.6 L/ac
   Water Volume: 45-120 L/ac
   Pressure: 200-300 kPa
8. SPRAYING TIPS:
   (a) Less effective when plants are stressed by lack of moisture, low temperature and/or very low relative humidity.
   (b) Apply 3 days before the use of any broadleaf herbicide.
   (c) Rhizomes of quackgrass should be thoroughly fragmented by tillage prior to application to obtain control at the lower rate.
   (d) Do not cultivate for 5 days after applying.
   (e) Add Agral® 90 at the rate of 1 L for every 1,000 L of spray solution (0.1% by volume). Do not add Agral 90 when tank mixed with other herbicides.
9. HOW IT WORKS: Systemic, readily translocated.
10. EXPECTED RESULTS: Weeds will cease growth, but death takes several weeks.
11. EFFECTS OF RAINFALL: No effect 2 hours after application.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: Do not harvest alfalfa, red clover, and bird's-foot trefoil for feed or graze livestock in the year of treatment.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (4,770). May cause skin and eye irritation.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) plus goggles. IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Not affected by freezing.

* **Registration for 1986 will be dependent on the results of the review of toxicological studies and exposure studies conducted in Canada during 1985.**

GLEAN (chlorsulfuron)
Dupont

1. FORMULATIONS: Dry Flowable 75%; 500 g container.
2. REGISTERED MIXES: Glean with Avenge 200C (wheat, barley), Surfactant, Roundup, Hoe-Grass, Stampede 360, and Mataven.
3. CROPS: Wheat (spring, durum, winter) (9.0), barley (9.0), oats. Spring application on winter wheat.
4. WEEDS CONTROLLED:
   buckwheat, wild (7.7)
   cleavers (8.2)
   chickwheed, common (8.6)
   cow cockle (9.0)
   flixweed
   hemp-nettle (8.3)
   kochia
   lamb's-quarters
   mustard, wild (8.0)
   pigweed, redroot (8.5)
   rapeseed, volunteer (8.1)
   smartweeds, annual (8.3)
   stinkweed (8.2)
   thistle (Canada (6.6), Russian (6.2))
5. WEEDS SUPPRESSED: Canada thistle (6.6), green foxtail.
6. WHEN USED: Wheat (spring, durum), winter wheat (spring application), barley, oats - 2 leaf to flag leaf (shot blade) stage. **Brown and Dark Brown Soils:** post harvest prior to planting spring wheat (except durum). Chemical Fallow (preceding wheat): post harvest prior to fallow or in spring during fallow. Glean + Roundup - fallow preceding wheat.
7. HOW TO APPLY:
   With: Ground equipment. Do NOT apply by air.
   Rate: 6, 9.2 or 12 g/ac. When tank mixed with wild oat herbicides, follow directions on specific labels. Fall, 8-12 g/ac. Fallow, 12 g/ac. Glean + Roundup, 12 g/ac + 0.3-0.4 L/ac + surfactant.
   Water Volume: 25 L/ac (minimum)
   Pressure: 275 kPa
   Nozzles: Flat fan types. Increased water volumes are required for flood jet or "Raindrop" nozzles.
   Surfactant: Use 1 L of Agsurf, Agral 90, or Cittowett Plus per 1000 L of spray mixture.
8. SPRAYING TIPS: Use metal or nylon filters only. Filters and screens 50 mesh or larger. Higher spray volumes required for dense crop canopy and/or large weeds. Continuous agitation is required. ***Ensure that Glean is completely suspended before adding other herbicides.*** Effectiveness may be reduced if spray mixture remains in tank for more than 24 hours. Do not exceed a total of 12 g/ac within a 12 month period.
   To avoid injury to crops susceptible such as canola thoroughly clean sprayer immediately after spraying as follows:
   1. Drain and flush tank, boom and hoses with clean water for a minimum of 10 minutes.
   2. Fill tank with clean water, add 0.5 L chlorine bleach (containing 5.25-6.0% sodium hypochlorite) per 100 L of water. Flush through boom and hoses, allow to sit for 15 minutes with agitation, drain.
   3. Repeat step 2.
   4. Nozzles and screens should be removed and cleaned separately. To remove traces of chlorine bleach, rinse tank thoroughly with clean water and flush through hoses and boom.
   NOTE: Do NOT use chlorine bleach with ammonia. All traces of liquid fertilizer containing ammonia or ammonium nitrate or ammonium sulphate must be removed from application equipment before adding chlorine bleach solution. This can be done effectively by rinsing with water, failure to do so will result in a release of a gas with a musty chlorine odor which can cause eye, nose, throat and lung irritation. Do NOT clean equipment in an enclosed area.
9. HOW IT WORKS: Absorbed by foliage and roots. Inhibits cell division.
10. EXPECTED RESULTS: ***Weeds:*** growth stops almost immediately. After 7-10 days yellowing or purpling will occur followed by complete desiccation. Glean remains active in soil throughout the growing season controlling later germinating weeds. ***Poor results may be expected if:*** improper mixing, timing, coverage or when weeds are under drought stress.
11. EFFECTS OF RAINFALL: Heavy rainfall immediately after application may cause temporary lightening of crop.
12. MOVEMENT IN SOIL: Movement is restricted by fine textured soils, soil organic matter and neutral to acidic conditions.
13. GRAZING AND CROPPING RESTRICTIONS: ***Grazing restrictions:*** None. ***Drift:*** Use extreme care to prevent drift onto desirable plants or non-target agricultural land. ***Succeeding Crops:*** Glean may only be used on land with pH 7.5 or less and used exclusively for production of wheat, barley or oats for at least the next 2 years. ***Recropping:*** Soils with pH 7.0 or less, wheat or barley may be seeded the following season (10 months). Soils with pH 7.1-7.5 **only** wheat may be seeded the following season. On soils with pH 7.1-7.5 barley may be seeded the second season (22 months). Recropping to peas or canola in Black Soil Zones, where pH is less than 7.0 and organic matter content is greater than 5% is possible after 3 seasons (34 months). If rainfall in any 1 season is less than 250 mm, extend this interval by 1 year.
    NOTE:
    (a) A field bioassay is required 1 year before sowing any other crop.
    (b) All cropping restrictions which apply to Glean alone will apply to wild oat herbicides + Glean tank mix.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (5,919).
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in a cool, dry place.

GRAMOXONE (paraquat)

Chipman

1. FORMULATIONS: Solution 200 g/L - 1 and 5 L containers.
2. REGISTERED MIXES: None Mix restrictions: Not applicable
3. CROPS: Shelterbelts, stale seedbed for vegetables and field crops, potatoes, sugar beets, non-crop land, and chemical mowing.
4. WEEDS CONTROLLED: A_{1} top growth, repeat applications may be necessary on perennial weeds. Annual weeds generally killed with 1 application.
5. WEEDS SUPPRESSED: Most perennial weeds.
6. WHEN USED: Prior to crop emergence, but soon after weeds emerge.
7. HOW TO APPLY:
   With: Ground equipment only.
   Rate: ***Shelterbelts:*** Apply 2.2 L Gramoxone in 440 L of water/ac or 75 mL in 10 L of water/100 m^2. 550 mL of this mixture will treat an area 1.75 m in diameter around a tree. ***Stale Bed Technique for Vegetable and Field Crops:*** Pre-emergent to crop, post-emergent to weeds: In beans (all types), beets, carrots, cole crops, corn, cucumbers, onions, peas, potatoes, soybeans, and turnips, prepare a seedbed at least 2-4 weeks before seeding to stimulate weed growth. Seed with minimum soil disturbance. To burn off emerged weeds apply 1-2 L Gramoxone in 120-440 L of water/ac prior to or after seeding. Do not apply later than 3 days before crop emergence. Use 2.0 L/ac when weeds are above 5 cm tall, and greater volumes of water on dense weed growth. ***Potatoes:*** Apply up to ground crack only for Netted Gem and Cherokee. For other varieties apply up until the first potato tops are 5-8 cm. To control quackgrass, annual grasses and broad-leaf weeds apply 1-1.75 L in 120-200 L of water/ac; for emerged seedlings thereof use only 610 mL of Gramoxone in 120-220 L of clean water/ac. **NOTE:** Application to exposed or emerged potato foliage will cause temporary injury and chlorosis. Do not apply to emerged potato foliage in evening, or when potatoes are under moisture stress due to extremely dry soil conditions, or to early potatoes. Use of poor or diseased seed and cut seed with 1 eye will make potatoes more susceptible to injury by post-emergence Gramoxone sprays. This will eliminate several cultivations, but will not control weeds that germinate after treatment. ***Non-Crop Land:*** Rapid top kill of weeds and grasses as a foilar spray. Apply 2.2-4.5 L of Gramoxone in 220-440 L/ac thoroughly wetting all foliage. ***Chemical Mowing:*** For rapid scorch of weeds and grasses, apply 1.0 L in 220-440 L of water/ac, thoroughly wetting all foliage. ***Weed Control in Non-Crop Land and Chemical Mowing:*** Gramoxone may be tank mixed with certain soil sterilants where immediate top kill and long-term sterilization are required.
   Water Volume: Thoroughly wet all foliage. For dense weed growth use the greater volume of water.
   Incorporation: Not applicable
   Pressure: 300 kPa
8. SPRAYING TIPS: Use high volume, low pressure type spraying equipment to thoroughly cover foliage. Special equipment is necessary to shield some row crops from spray. Applications on cloudy days, or just prior to or during periods of darkness will generally increase effectiveness of the treatment. Do not apply with mist blowers. It is important to thoroughly wash equipment after spraying - use a wetting agent (Agral 90 at 60 mL/100 L of water), flush and spray out, then thoroughly rinse with clean water. If possible, equipment should be filled with clean water and left overnight. Spray out before storing equipment or using other materials. Use only clean water to avoid reduction in effectiveness.
9. HOW IT WORKS: Gramoxone is absorbed by leaves and stems, but does not translocate.
10. EXPECTED RESULTS: Gramoxone provides immediate, fast and virtually complete annual weed kill from 1 application. Repeat applications may be necessary for perennial weeds. Yellowing occurs within a few hours and desiccation of the plant continues rapidly until death. Gramoxone is inactivated on contact with soil, it has no residual effect. Rain prior to spray solution drying on plant or muddy water will reduce effectiveness of the chemical.
11. EFFECTS OF RAINFALL: Once spray solution has dried on plant tissue, rain will not reduce effectiveness of Gramoxone.
12. MOVEMENT IN SOIL: Gramoxone binds to the soil and becomes biologically unavailable.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Prevent drift onto crops, ornamentals lawns, grazing areas or other desirable areas. ***Grazing Restrictions:*** Not applicable ***Crop Use After Hail:*** and ***Succeeding Crops:*** No restriction.
14. TOXICITY: Very high acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (120). Symptoms of acute poisoning may occur. May be fatal if swallowed.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2), goggles and respirator. KEEP OUT OF REACH OF CHILDREN AND ANIMALS. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). See a doctor immediately.
16. STORAGE: NEVER transfer to other containers. Heated storage preferred. Will crystallize if frozen.

HERBEC 20P (tebuthiuron)

Elanco

Available only to approved personnel

1. FORMULATIONS: 20% Pellets - 20 kg bag
2. REGISTERED MIXES: None registered. Mix restrictions: Not applicable. Mixing with other pesticides: Not recommended.
3. CROPS: Industrial brush control.
4. WEEDS CONTROLLED: Alder, balsam fir, birch, pine, poplar, spruce (black, white), tamarack, willows.
5. WEEDS SUPPRESSED: Not applicable.
6. WHEN USED: Herbec 20P may be applied any time the ground is not frozen or snow-covered. Summer and fall applications will control brush the following year.
7. HOW TO APPLY:
   With: Air or ground granular applicator
   Rate: 6.9-8.9 kg/ac
8. SPRAYING TIPS:
   (a) Do not use on or near field crops, desirable trees or shrubs, or areas into which their roots may extend or in locations where the chemical may be washed into contact with their roots, as injury or death may occur.
   (b) The granular applicator must be properly calibrated to ensure uniform distribution.
9. HOW IT WORKS: Absorbed by roots. Applied to the soil surface it is moved slowly into the soil by rainfall. The rate of movement depends upon soil-type, amount of rainfall. Shallow-rooted species will be killed more quickly than deep-rooted species.
10. EXPECTED RESULTS: Product applied in the summer and fall of 1 year will start to control brush later in the following year. Some species may undergo repeated defoliation and complete kill may come as late as 24-36 months after application. Since the number of pellets/ac is very low, the effect on ground cover is minimal. Application onto frozen ground may give poor results.
11. EFFECTS OF RAINFALL: Increased rainfall will increase the speed at which this product kills brush.
12. MOVEMENT IN THE SOIL: To be effective Herbec 20P must be leached into the root zone of the brush. Movement in the soil is vertical and not lateral. Depth of leaching rarely goes beyond 18 inches (45 cm).
13. GRAZING AND CROPPING RESTRICTIONS: ***Grazing Restrictions:*** Do not graze treated area. ***Succeeding Crops:*** An industrial brush control for use on non-crop land.
14. TOXICITY: Slightly high mammalian toxicity; oral LD_{50} rats (mg/kg) = (644). Not toxic to cattle. Slightly toxic to birds and fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in a dry area.

HERITAGE (trifluralin)

Elanco

Wheat – Brown Soil Zones Only

1. FORMULATIONS: Granular 5%; 25 kg bag.
2. REGISTERED MIXES: None
3. CROPS: Wheat (spring, durum) (8.6). Underseeding: Not recommended.
4. WEEDS CONTROLLED: ***Fallow Year:***

   buckwheat, wild (8.3) | foxtail, green (8.1) | lamb's-quarters (8.0) | pigweed, redroot (8.2)
   cow cockle (9.0) | grass, barnyard (8.3) | oats, wild (7.5) | thistle, Russian
   darnel, Persian

   Crop Year: Green foxtail and lamb's-quarters.
5. WEEDS SUPPRESSED: Crop Year: Wild buckwheat, wild oats.
6. WHEN USED: Apply to summerfallow in May, June and July for weed control during both years of a summerfallow-wheat rotation. Maximum benefit comes when applied as early as possible in the fallow year.
7. HOW TO APPLY:

   With: Ground equipment with granular applicator.

   Rate: May 8.9 kg/ac, June 7.7 kg/ac, July 6.5 kg/ac. Brown Soil Zones Only.

   Incorporation: If green growth prevents proper mixing, it must be destroyed before application. Apply over standing or pre-worked stubble, provided straw is chopped and evenly distributed. Incorporate within 24 hours of application to 5-8 cm with cultivator (field or deep tillage) at 10-13 km/h or disc at 7-10 km/h. Do second incorporation at the same depth and right angles to the first whenever necessary to control resistant weeds in fallow year. Cultivation with a rodweeder or shallow tillage cultivator may be required. Do not cultivate when soil is crusted, lumpy or too wet for good mixing action or in soils with more than 8% organic matter. Working deeper than 8 cm can result in erratic weed control and crop injury.
8. SPRAYING TIPS: Do not apply on soils subject to prolonged flooding, sandy soils with less than 1% organic matter, or soils in poor working condition. Application to severly eroded knolls may result in reduced crop stands. In the fall, prior to application , spread straw evenly over field and leave stubble standing to trap snow. For maximum effectiveness apply in May. In crop year, after application and when soil is warm enough for good germination, prepare seedbed with field cultivator set at 5 cm deep. Seed into a weed-free seedbed, 3-6 cm deep, using double disc or hoe drill. Separate spring tillage may not be necessary with a discer or airseeder. Pack or harrow after seeding. Drought conditions in fallow year, prior to seeding, may result in higher carryover of Heritage at seeding time. To reduce possible injury by carryover, seeding to the correct depth (3-6 cm) is critical. After filling granular applicator, close lid quickly to avoid exposure to direct sunlight.
9. HOW IT WORKS: Seedlings are killed during germination by inhibited cell division at active growing points. This results in puffy, brittle, slow growing shoots and swollen brittle root tips. Established weeds are not controlled.
10. EXPECTED RESULTS: ***Weeds:*** After first incorporation, susceptible weeds are partially controlled. After second operation, susceptible weeds are controlled before emergence. ***Crop:*** No injury to wheat, after summerfallow. Over-application may reduce crop stand, delay development or reduce yields.
11. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (10,000). Non-toxic to bees; very toxic to fish. Large amounts of Heritage can be tolerated by fish in runoff or muddy water because it binds to suspended soil.
12. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to reduce exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
13. STORAGE: Store in areas not exposed to high temperatures, prolonged direct sunlight or moisture.

SPECIAL USE: Fall application only - Wheat (spring, durum).
Weeds Controlled: Green Foxtail.
When Used: Fall application only - Sept. 1 to freeze up.
Rate: 4.5 kg/ac.
Incorporation: (as above) First incorporation within 24 hours of application, 5-8 cm deep. Second incorporation at same depth and right angles to first, in the fall at least 3 days later or in the spring during seedbed preparation.

HOE-GRASS II (diclofop-methyl/bromoxynil)

Hoechst

1. FORMULATIONS: Emulsifiable concentrate 230 g/L diclofop-methyl + 80 g/L bromoxynil - 20 L.
2. REGISTERED MIXES: Hoe-Grass II + MCPA (amine or Ester), Decis.
3. CROPS: Wheat (spring (8.7), durum), barley (8.4) (do not apply to 2-row varieties), flax (7.6), triticale, spring rye. Do not treat crops underseeded to legumes.
4. WEEDS CONTROLLED:

buckwheat, Tartary (7.2)	corn, volunteer (8.4)	knawel	oats, wild (7.4)
buckwheat, wild (8.0)	darnel, Persian (2.0)	kochia (8.2)	pigweed, redroot (8.8)
catchfly, night-flowering (8.8)	foxtail (green, yellow (7.4))	lamb's-quarters (8.6)	smartweed, green (8.8)
chamomile, scentless (8.7)	grass, barnyard (9.0)	mustard, wild (8.3)	stinkweed (8.2)
cow cockle (7.9)	groundsel, common (9.0)		thistle, Russian (8.9)

5. WEEDS SUPPRESSED: None
6. WHEN USED: 1-4 leaf stage of wild oats, green and yellow foxtail, and barnyard grass. 1-3 leaf stage of persian darnel and a height of 15-25 cm for volunteer corn. Broadleaved weeds are controlled from seedling to early 4 leaf stage (except for Russian thistle where the stage is seedling to 5 cm in height). Flax 5-10 cm in height.
7. HOW TO APPLY:
   With: Ground equipment only. Do not apply by air.
   Rate: 1.4 L/ac
   Water Volume: 45 L/ac
   Pressure: 275 kPa.
   Nozzles: Do not use flood jet type nozzles or controlled droplet application equipment.
8. SPRAYING TIPS:
   (a) Nozzles should be tilted 45° forward to ensure better coverage.
   (b) For best results and maximum yield enhancement, apply when majority of weeds are in the 2-3 leaf stage.
   (c) During periods of stress (heat, drought or low humidity) reduced weed control may result.
   (d) Hoe-Grass II must be applied at least 4 days before the use of any other herbicide to eliminate a reduction of control.
9. HOW IT WORKS: Diclofop-methyl possesses contact as well as systemic action. Uptake is primarily through the leaves. The site of action is the growing point. Bromoxynil is primarily a contact herbicide with limited translocation in susceptible annual broadleaved weeds.
10. EXPECTED RESULTS: Yellowing of susceptible plants are visible within 2-4 days. New leaf growth exhibits light chlorosis which deepens and browning develops within 10-14 days of application. Photosynthesis and growth are inhibited and uptake of water and nutrients ceases. Lack of adequate crown root development is 1 of the most distinguishable features of diclofop-methyl activity.
    Bromoxynil activity is evident within 24 hours as necrotic spots appear on the leaves of susceptible broadleaved weeds. This damage spreads rapidly until the plants ultimately die. Chlorosis may develop in the untreated leaves of these susceptible weeds even though very little movement of the bromoxynil occurs. **Precautions:** ***Barley*** - Hoe-Grass II must be applied in the 1-4 leaf stage of the barley and prior to tillering. Application beyond the 4 leaf stage or after tillering will result in crop damage. Under certain environmental conditions, yellow blotches may appear on the barley leaves. These blotches will be rapidly outgrown and will not affect maturity or yield. DO NOT APPLY TO TWO-ROW BARLEY VARIETIES IN ALBERTA. ***Flax*** - Hoe-Grass II must be applied when the flax is 5-10 cm in height. Do not spray flax during periods of heat or humidity stress as it may cause leaf burn, retarded growth and a slight maturity delay.
11. EFFECTS OF RAINFALL: Rainfall within 1 hour will decrease activity.
12. MOVEMENT IN SOIL: Some movement may occur if sufficient moisture is present.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Avoid treatment near susceptible crops. ***Grazing Restrictions:*** Do not graze treated field prior to harvest. Do not use treated field for green forage. Do not apply Hoe-Grass II within 60 days of harvest. ***Succeeding Crops:*** No restriction.
14. TOXICITY: Very low toxicity; acute oral LD_{50} rats (mg/kg) = (2,350). Eye irritant. Toxic to fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) plus goggles to reduce eye exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting but rush person to nearest hospital.
16. STORAGE: Do not store below freezing. If stored for 1 year or longer, shake well before using.

HOE-GRASS 284 (diclofop-methyl)

Hoechst

WARNING POISON

1. FORMULATIONS: Emulsifiable concentrate - 284 g/L - 20 L pack.
2. REGISTERED MIXES: Hoe-Grass 284 + Torch, Torch DS, Pardner, Lontrel, Glean, Decis.
3. CROPS:

barley (except Klages, Betzes) (8.2)
beans, dry common (8.8) (black, white + pinto only)
buckwheat, tame (8.1)
carrots
fababeans (9.0)
flax (8.9)
lentils (8.4)
mustard, tame (8.9)
onion, dry bulb (8.6)
peas (field, canning) (9.0)
potatoes (8.7)
rapeseed (8.9)
rye, fall (9.0)
rye, spring (8.7)
soybeans (8.8)
sunflowers (8.4) (except Corona variety)
triticale (8.8)
wheat, spring (8.5)
wheat (winter, durum) (9.0)

Following Perennials:
grasses, legumes for seed, in year of establishment:
alfalfa (9.0)
bromegrass
clover (red, sweet)
fescue, creeping red (8.8)
ryegrass, Russian wild (7.6)
wheatgrass, crested (8.2)
wheatgrass, intermediate

4. WEEDS CONTROLLED: Wild oats (7.7), foxtail (green, yellow) (7.6), barnyard grass (8.0), Persian darnel (7.0), volunteer corn.
5. WEEDS SUPPRESSED: None
6. WHEN USED: 1-5 leaf stage of wild oats, 1-4 leaf stage of green and yellow foxtail, and barnyard grass. 1-3 leaf stage of persian darnel and a height of 15-25 cm for volunteer corn. Apply to barley in the 1-4 leaf stage and prior to tillering.
7. HOW TO APPLY:
   With: Ground or aircraft.
   Rate: 1.0 L/ac. ***Special Crops:*** 1.4 L/ac. ***Wild oats:*** in the 4-5 leaf stage, apply at 1.1 L/ac. ***When tank mixing with bromoxynil:*** use 1.1 L/ac.
   Water Volume: Aircraft - minimum of 15 L/ac, Ground - 44 L/ac
   Pressure: Aircraft - 300 kPa, ground - 275 kPa
   Nozzles: Do not use flood jet nozzles.
8. SPRAYING TIPS: Nozzles should be tilted 45° forward to ensure better coverage. When tank mixing with bromoxynil do not delay Hoe-Grass 284 application if grassy weed is in correct stage. Reduced control can be expected if Hoe-Grass 284 is applied to weeds growing under stress. Control may be further reduced if tank mixed. Apply at least 4 days before any broadleaf herbicide, except bromoxynil products, to eliminate a reduced grass kill from Hoe-Grass 284. Do not use Controlled Droplet Application equipment.
9. HOW IT WORKS: Contact as well as systemic action. Uptake primarily through leaves and translocated to growing point. Penetration and uptake via roots may occur if soil is sufficiently moist and the rate of application is relatively high.
10. EXPECTED RESULTS: Yellowing of susceptible plants is noticeable within 2-4 days of application. New leaf growth exhibits light chlorosis which deepens and browning develops 10-14 days after application. Photosynthesis and growth are inhibited and uptake of water and nutrients ceases. Lack of adequate crown root development is evident on wild oats as well as in some sensitive barley varieties.
11. EFFECTS OF RAINFALL: Rainfall within 1 hour will decrease activity.
12. MOVEMENT IN SOIL: Some movement in soil if sufficient moisture is present.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Danger from drift is low. ***Grazing Restrictions:*** Do not graze treated green crop. Do not apply within 60 days of harvest. ***Succeeding Crops:*** No restriction.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (2,235). Toxic to fish; non-toxic to birds.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention immediately.
16. STORAGE: Do not store below freezing. If stored 1 year or longer, shake well before using.

HYVAR X (bromacil)

DuPont

1. FORMULATIONS: 80% wettable powder - 25 kg, 2 kg packs. Water soluble liquid: 240 g/L (Hyvar X L) - 4 L, 10 L packs.
2. REGISTERED MIXES: None
3. CROPS: Non-crop land only. Total vegetation control.
4. WEEDS CONTROLLED: Hyvar X is a non-selective, total vegetation control chemical for weeds, grasses and some brush as: alder, aspen and balsam poplar, ash.
5. WEEDS SUPPRESSED: Not applicable
6. WHEN USED: See "Soil Sterilants" page 4.
7. HOW TO APPLY:
   a) Hyvar X Liquid
   With: Power sprayer. Handguns, backpack sprayers or a watering can may be used to treat small areas.
   Rate: ***Initial treatment:*** Apply 12-18 L/ac. Higher dosage on soils containing 5% or more organic matter, or soils high in clay content. ***Retreatment to control regrowth as alfalfa:*** 7-9 L/ac. ***For small areas:*** apply 450 mL on 100 m². ***Brush Control:*** Spot Treatment - apply undiluted at 8 mL/m of tree height up to 3 m. Four or five 8 mL deposits around the root collar for brush taller than 3 m.
   b) Hyvar X
   Same as Hyvar X L, except more efficient agitation of the spray solution is required.
   Rate: ***Initial treatment:*** 3-5 kg/ac. Use the higher dosage on soils containing 5% or more organic matter, or soils high in clay content. ***When weeds and grasses reappear:*** apply 1.5-2.7 kg/ac ***Brush Control*** Mix 870 g Hyvar X in 10 L of water and apply 30-60 mL/stem 5-10 cm in basal diameter. Wet base of stem to point of runoff.
   Water Volume: For application of Hyvar X L with a handgun apply 650 L of spray solution/ac. For mixing of Hyvar X use a minimum of 20 L of water/kg of Hyvar X. See "Soil Sterilants" page 4.
8. SPRAYING TIPS: See "Soil Sterilants" page 4.
9. HOW IT WORKS: Hyvar X is readily absorbed through the roots but much less readily through the leaves. Once in the plant it inhibits photosynthesis. **Caution:** Do not apply closer than 1.5 times the height of desirable vegetation.
10. EXPECTED RESULTS: Susceptible plants become chlorotic and then die. Vegetation kill is faster with higher rainfall. ***Poor results may be expected if:*** weed growth too mature or if there is insufficient rainfall.
11. EFFECTS OF RAINFALL: Rainfall will carry the chemical into the root zone where it is absorbed.
12. MOVEMENT IN SOIL: Movement in soil is dependent upon soil type and soil moisture. Bromacil will move faster in a vertical direction in sandy soils than in soils high in organic matter or clay content. Movement can be severe on slopes.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** All crops and ornamentals may be injured by chemical drift. Do not apply in areas subject to severe soil erosion.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (5,200). Toxic to fish.
15. PRECAUTIONS AND FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Hyvar X - Store in a cool dry place. Hyvar X L - Combustible, keep away from heat or open flame. Do not allow to freeze.

KARMEX (diuron)

DuPont

1. FORMULATIONS: 80% wettable powder - 2 kg, 25 kg packs.
2. REGISTERED MIXES: None
3. CROPS: Asparagus; irrigation and drainage ditches, ponds, dug-outs and spot treatment for general weed control. Non-crop areas.
4. WEEDS CONTROLLED: Broad leaved and grassy weed seedlings.
5. WEEDS SUPPRESSED: Not applicable
6. WHEN USED: Karmex may be used at any time, except when the ground is frozen. Sufficient rainfall or irrigation is necessary following treatment to carry the chemical to the root zone.
7. HOW TO APPLY:
   With: Field sprayer, hand sprayer, back-pack or sprinkling can.
   Rate: ***General Weed Control:*** Apply 5.8-11 kg/ac on sand or sandy soils. Apply 16-22 kg/ac on clay or high organic soils. Use the lower rate when annual weed growth predominates and where only one season's control is desired. ***Retreatment:*** When regrowth begins apply 500 g/ac to control annuals and seedlings. ***Irrigation and Drainage Ditches:*** Apply 250-750 g/100 m^2 or 9.3-27 kg/ac. Apply during the non-crop season when the ditch is not in use. Flush once before using for irrigation purposes. Karmex must be fixed in the soil by moisture to minimize movement in irrigation water. ***Spot Treatment:*** Spot treat at 0.75-1.0 kg/100 m^2 to control couch grass and toadflax. A rate of 50 g of Karmex applied on 10 m^2 is equal to 20.2 kg/ac.
   Water Volume: Use 100-160 L of water/acre to provide thorough, uniform coverage.
8. SPRAYING TIPS: See "Soil Sterilants" page 4.
9. HOW IT WORKS: Diuron is readily absorbed through the root system and less readily absorbed through stem and foliage.
10. EXPECTED RESULTS: Susceptible plants become chlorotic soon after treatment and then die. Poor control may be expected from inadequate rate or weeds too old or insufficient rainfall. Application on slopes may cause erosion. Application too near feeding roots of susceptible vegetation may cause injury.
11. EFFECTS OF RAINFALL: Rainfall will activate the chemical, carrying it into the root zone.
12. MOVEMENT IN THE SOIL: Diuron absorbs readily to the soil and there is little movement by leaching.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** All crops and ornamentals may be injured by chemical drift. ***Succeeding Crops:*** Only on non-crop land.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (3,400). Non-toxic to birds and fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in a cool dry place.

KERB 50W (propyzamide)
Rohm and Haas

1. FORMULATIONS: 50% Wettable Powder - 2.0 kg bags
2. REGISTERED MIXES: None specified.
3. CROPS: Alfalfa (first year and established) (8.7), grass (established), pastures - grass/legume bird's-foot trefoil.
4. WEEDS CONTROLLED:

barley, foxtail (7.5)	grain, volunteer	oats, wild (5.9)	timothy
chickweed (8.2)	grass, orchard (8.3)	quackgrass, seedling (7.4)	

5. WEEDS SUPPRESSED: None.
6. WHEN USED: Fall - alfalfa, bird's foot trefoil. Spring - alfalfa seed crops.
7. HOW TO APPLY:
   With: Ground equipment only.
   Rate: ***Pastures:*** 360 g/ac on brown, dark brown, gray wooded soils. 450 g/ac on thin black and black soils. ***First year and established legumes:*** 710 g/ac. Fall or spring - controls annual grasses as volunteer cereals or wild oats 910 g - 1.3 kg/ac. Fall only - controls quackgrass, orchard grass, timothy, chickweed. **Water volume:** 40-200 L/ac
   Incorporation: None. Spring application on alfalfa seed crops - if soil temperature is high and moisture low - a light incorporation is suggested.
   Pressure: 275 kPa.
   Nozzles: Flat fan.
8. SPRAYING TIPS: ***Fall Application:*** when soil temperature is low but above freezing and soil moisture high. Rain in a day or 2 or light overhead irrigation improves results. ***Spring Application:*** Best when soil temperature is cool. Do not use on high organic matter, peat or muck soils. Spray overlaps may seriously injure desirable grass. Apply between October 1 and freeze up. Do NOT use on timothy, fescue or perennial blue grass. Do NOT use in seed grass stands. Use 50 mesh or larger metal filters and nozzle screens. Best results when soil temperature is low but above freezing and soil moisture high.
9. HOW IT WORKS: Root absorption. Inhibits cell division.
10. EXPECTED RESULTS: Plant growth stops, turns brown and dies.
11. EFFECT OF RAINFALL: Improves efficacy.
12. MOVEMENT IN SOIL: Very little leaching. Readily absorbed on organic matter.
13. GRAZING AND CROPPING RESTRICTIONS: Do not harvest or graze within 90 days of applying 1.3 kg/ac or 60 days after lower rates. Wait 9 months before planting other crops.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) rats = (8,350).
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to avoid exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Store in cool dry place.

KROVAR I (bromacil + diuron)
DuPont

1. FORMULATIONS: 40% diuron + 40% bromacil, 2 and 25 kg.
2. REGISTERED MIXES: None
3. CROPS: Non-crop land only. Total vegetation control.
4. WEEDS CONTROLLED: Most annual and perennial weeds and grasses.
5. WEEDS SUPPRESSED: Not applicable
6. WHEN USED: Apply Krovar I before weeds emerge or when actively growing. Sufficient moisture is required to carry the chemical to the root zone of the weeds.
7. HOW TO APPLY:
   With: Boom sprayer, hand gun, back pack, or sprinkling can.
   Rate: ***General Weed Control:*** Apply 5.3-7.3 kg/ac to control annual and perennial grasses and most broad-leaved weeds. Use higher rates on soils containing 5% or more organic matter or soils high in clay content. Use the 5.5 kg/ac rate on sandy or sandy loam soils only. ***Retreatment:*** Apply 2.75-3.6 kg/ac when annual weeds reappear on previously treated sites. ***Small Areas:*** 180 g Krovar I on 100 m^2.
   Water Volume: Use a minimum of 20 L of water/kg of Krovar I.
8. SPRAYING TIPS: See "Soil Sterilants" page 4.
9. HOW IT WORKS: Readily absorbed through the roots, leaves and stems.
10. EXPECTED RESULTS: Plants become chlorotic and then die. ***Poor results occur if:*** weeds are too mature or insufficient rainfall.
11. EFFECTS OF RAINFALL: Rainfall will leach the chemical into the root zone.
12. MOVEMENT IN SOIL: Soil movement is faster with heavier rainfall. Do not use in areas subject to soil erosion.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** All crops and ornamentals may be injured by chemical drift. ***Succeeding Crops:*** Krovar I is a non-selective residual herbicide. It should only be used on non-crop land where bare ground is desired.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = bromacil (5,200), diuron (3,400). Non-toxic to birds; toxic to fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in a cool, dry place.

LADDOK (bentazon + atrazine)
BASF

1. FORMULATION: Flowable - bentazon - 200 g/L + atrazine 200 g/L - 10 L pack.
2. REGISTERED MIXES: None
3. CROPS: Corn (field, silage, sweet)
4. WEEDS CONTROLLED:

chickweed, common	lamb's-quarters	pigweed, redroot	smartweed
cocklebur	mustard, wild	purslane	spurry, corn
groundsel, common	nightshade, black	ragweed, common	

5. WEEDS SUPPRESSED: None.
6. WHEN USED: Apply 18-28 days after seeding. Corn tolerant at all growth stages.
7. HOW TO APPLY:
   With: Ground.
   Rate: 0.8-1.6 L/ac. Assist Oil Concentrate - 10 L/1000 L of spray volume is recommended.
   Water Volume: 80-160 L/ac
   Pressure: 275-400 kPa
   Nozzles: Flat fan or cone type. Do not use flood jet type.
8. SPRAYING TIPS: Best results if weeds are young and actively growing.
9. HOW IT WORKS: Both bentazon and atrazine are contact herbicides interfering with photosynthesis.
10. EXPECTED RESULTS: ***Weeds:*** turn yellow, then brown, usually within 2 weeks. ***Crops:*** occassionally show light leaf speckling. ***Poor results may occur if:*** weeds are too mature, failure to penetrate crop canopy or under conditions of prolonged cool weather or drought.
11. EFFECTS OF RAINFALL: Within 6-8 hours may reduce activity.
12. MOVEMENT IN SOIL: Very little, except in sandy soil and with excessive moisture.
13. GRAZING AND CROPPING RESTRICTIONS: ***Grazing Restrictions:*** Treated plants can be used for silage. ***Succeeding Crops:*** On very light soils with low organic matter some atrazine may carry over and injure susceptible crops.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (3,000).
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in a cool dry place above 0°C.

LEXONE (metribuzin)
DuPont

1. FORMULATIONS: Lexone DF (75% dry flowable), 2.5 kg container. Lexone L (480 g/L), 10 L container.
2. REGISTERED MIXES: Both formulations can be mixed with Treflan, MCPA amine, Banvel or Eptam.
3. CROPS: Barley (not Klondike) (8.9), fababeans, peas, field, potatoes (8.6) (except red skinned, early Shepody, ND 146-4R, Rideau, Bellisle or Tobique), tomatoes, wheat (8.5).
4. WEEDS CONTROLLED:

chickweed (8.1)	lamb's-quarters (8.4)	pigweed, redroot	smartweeds, annual (8.5)
hemp-nettle (8.4)	mustard (ball, wild)(8.0)	rapeseed, volunteer (8.8)	spurry, corn (7.1)
lady's-thumb		shepherd's-purse	stinkweed (8.2)

5. WEEDS SUPPRESSED: None
6. WHEN USED: ***Wheat, barley:*** 2-5 leaf stage ***Tomatoes:*** Tomato transplants grown for processing only. Apply as directed spray before weeds are 4 cm high. ***Potatoes:*** Do not use on sandy or coarse textured soils containing less than 1% organic matter as crop injury may result. Potato varieties vary in their resistance to Lexone. Use on limited area to determine safety before large scale sprays are adopted. ***Irrigated Potatoes (except Belleisle and Tobique):*** Pre-emergence, single application after planting (at least 5 cm deep) or hilling before crop emerges. Early post-emergence, apply following 3 or more days of sunny weather. Treat before weeds are 3 cm and potatoes are less than 10 cm. Some leaf burn may occur. Pre-emergence + post-emergence, follow above directions but do not apply more than 0.57 kg/ac per season. ***Dryland Potatoes:*** Early post-emergence, apply soon after emergence and before weeds are 4 cm high. Preplant incorporated, apply as by Eptam label. Crop injury may occur if used on soil with greater than 7% organic matter or on sandy or coarse textured soils with less than 2% organic matter. ***Fababeans:*** With Treflan as a preplant incorporated treatment in the fall or spring.
7. HOW TO APPLY:
   With: Ground equipment
   Rate: ***Wheat:*** Lexone DF - 110 g/ac. Tank mixed with Banvel at 110 mL/ac or MCPA amine-500 at 345-445 mL/ac for broader weed spectrum. ***Barley:*** Lexone DF - 110-140 g/ac. Can be tank mixed with MCPA amine-500 at 345-445 mL/ac. The low rate can be mixed with Banvel at 110 L/ac. ***Irrigated Potatoes:*** Pre-emergence, 340-485 g/ac in 60-120 L water/ac. Early post-emergence, 285-390 g/ac. Pre-emergence + post-emergence, apply no more than 565 g/ac. ***Dryland Potatoes:*** Early post-emergence, 140 g/ac. Preplant incorporated, 140-200 g/ac Lexone DF plus 1.7-1.8 L/ac Eptam in 80-120 L water/ac. ***Fababeans:*** Spring preplant incorporate, 140-220 g/ac plus 810 mL/ac Treflan. Fall preplant incorporate, 160-220 g/ac plus 810 mL-1.05 L/ac Treflan. ***Tomatoes:*** 200-710 mL/ac Lexone L, 430-450 g/ac Lexone DF.
8. SPRAYING TIPS: Use 50 mesh line strainer and screens. Shake container well before adding to sprayer tank. Do not spray if rain is expected within 2 hours. Allow 4-5 day interval before or after application of wild oat herbicides. If frost occurs, allow 4-5 day interval for crop to recover before applying Lexone. Crop must be planted at least 5 cm deep. Do not apply to tomatoes within 60 days of harvest.
9. HOW IT WORKS: A systemic herbicide absorbed by foliage and roots. Affected plants become chlorotic and stunted. Death usually occurs 10-14 days after treatment. Because Lexone leaves a residue in the soil, control of shallow germinating weeds (eg. chickweed) occurs throughout the growing season.
10. EXPECTED RESULTS: ***Weeds:*** Should start to yellow within 7-10 days after treatment. ***Crop:*** Temporary (7-10 days) lightening in crop color and occasionally a slight reduction in crop height may occur, especially if frost or abnormally high temperatures occur within 1-2 days of application. Injury to barley can occur if there is shading for 12 hours after spraying. Thus avoid late evening or cloudy day applications. ***Poor results may be expected if:*** it rains immediately after application or weeds are under stress or too mature.
11. EFFECTS OF RAINFALL: Heavy rainfall immediately after application may decrease activity.
12. MOVEMENT IN SOIL: Not applicable
13. GRAZING AND CROPPING RESTRICTIONS: ***Grazing Restrictions:*** Do not graze or feed to livestock within 30 days of application. ***Succeeding Crops:*** No restrictions. **NOTE:** ***Potatoes*** - do not apply within 60 days of harvest.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,100). Slightly toxic to fish and birds; non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Lexone DF - Cool dry place. Lexone L - warm storage preferred. If frozen ensure material has been thoroughly resuspended.

LONTREL (clopyralid)
DOW

1. FORMULATIONS: Solution, 200 g/L; 4 L container.
2. REGISTERED MIXES: Hoe-Grass Poast.
3. CROPS: Canola/Rapeseed (8.6). Underseeding not recommended for forage legumes.
4. WEEDS CONTROLLED:

buckwheat, wild (6.1)	hawk's-beard, narrow-leaved	sunflower, volunteer	thistle, Canada (8.3)
chamomile, scentless	ragweed, common	sow-thistle, perennial (7.0)	

5. WEEDS SUPPRESSED:

buckwheat, Tartary	cocklebur	mallow, round-leaved	smartweed, annual
cleavers	lamb's-quarters	pigweed, redroot	

6. WHEN USED: 2-6 leaf stage of canola (rapeseed).
7. HOW TO APPLY:
   With: Ground equipment
   Rate: 405-605 mL/ac
   Water Volume: 40 L/ac
   Pressure: 200-275 kPa
8. SPRAYING TIPS: Treat during warm weather when weeds are actively growing.
9. HOW IT WORKS: Absorbed by leaf and stem surfaces and readily translocated. Maximum efficacy results from foliar application to young actively growing plants.
10. EXPECTED RESULTS: Growth will first slow then cease. Death of weed will not occur until 14-21 days after treatment.
11. EFFECTS OF RAINFALL: A rain free period of 4-6 hours is required.
12. MOVEMENT IN SOIL: Small amounts may carry over in soil into the year after treatment, but is generally not mobile in soil under typical prairie conditions.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Small amounts of drift may damage broad-leaved plants. ***Rotational Crops Recommended:*** Wheat, barley, oats, rye, flax, canola, summerfallow. ***Grazing Restrictions:*** None. ***Succeeding Crops:*** Do not seed to crops other than those listed above, the year after treatment.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats = greater than 5,000 mg/kg. Oral LD_{50} bees = greater than 100 ug/bee. Extremely low toxicity to fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to reduce exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Store away from food, feedstuffs, fertilizer, seeds, insecticides, fungicides, or other pesticides. Store in heated storage. If frozen, warm to room temperature and agitate.

LOROX L (linuron)

DuPont

1. FORMULATION: Flowable suspension - 480 g/L, 10 L container.
2. REGISTERED MIXES: Lorox L+MCPA amine, Lorox L+Atrazine 80W (field corn), Lorox L+Estamine, Lorox L+Sweep+MCPA amine, Lorox L+Target, Lorox L+MCPA-K
3. CROPS:

Lorox L
asparagus (8.7)
carrots (8.2)
corn, field (6.5)
potatoes (8.7)
shelterbelts; fruit trees (apple, pear, plum, cherry)

Lorox L+MCPA amine 500
barley (8.6)
oats (8.9)
wheat (spring, durum)(8.2)

4. WEEDS CONTROLLED:

Lorox L
barnyard grass (8.3)
buckwheat (Tartary, wild)(8.5)
chickweed (9.0)
corn spurry (8.7); cow cockle
foxtail (green, yellow)(6.7)
goosefoot (8.4)
groundsel (8.6)
knotweed; kochia (6.4)
lamb's-quarters (7.9)
mustard, wormseed (8.9)
pigweed (prostrate, redroot)(8.3)
purslane (8.4); ragweed
shepherd's-purse
smartweeds, annual (9.0)
stinkweed (8.5); wild radish

Lorox L+MCPA amine 500
buckwheat, Tartary (7.3)
cocklebur
common burdock
goat's-beard
hemp-nettle (7.5)
lady's-thumb (7.0)
mustard (ball, hare's ear, Indian, tumble, wild)(8.8)
smartweed, green (7.0)
stork's bill (8.3)

5. WEEDS SUPPRESSED: Canada thistle (4.4).
6. WHEN USED: **WEEDS:** 1-4 leaf stage. ***Green foxtail:*** 1-3 leaf stage. **CROPS:** ***Asparagus:*** immediately after discing, before emergence, may be repeated after last cutting. ***Carrots:*** Post-emergence; 2 or more fully developed true leaves, 10-15 cm tall. ***Cereals:*** 2-4 leaf stage. ***Corn:*** Pre-emergence Lorox L+Atrazine. Post-emergence Lorox L alone after corn is at least 38 cm tall, directed spray. ***Fruit trees:*** Apply as directed spray under trees and bushes before buds open and before weeds 10 cm tall. ***Potatoes:*** Pre-emergence; before grassy weeds 8 cm tall, broad-leaf weeds 15 cm tall. **Shelterbelts:** Apply only on stock planted for as least 1 year as directed spray under trees and bushes before buds open and before weeds 10 cm tall. **Fallow:** Once per season in spring when weeds 2-4 leaf.
7. HOW TO APPLY:
   With: Ground equipment or air.
   Rate: ***Asparagus:*** Pre-emergence (crop) 1.4-1.8 L/ac in 120 L water/ac. ***Carrots:*** Pre-emergence (crop) 450-1375 mL/ac in 80-120 L water/ac. Post-emergence (crop) 0.9-1.8 L/ac in 80-120 L water/ac. Combination pre-emergence and post-emergence (crop) 450-1900 mL/ac followed by 0.9-1.8 L/ac, provided treatments are at least 2 weeks apart. ***Cereals:*** Lorox L 170-225 mL/ac+MCPA amine 345-445 mL/ac. ***Corn (field):*** Pre-emergence; (a) low organic soils (2% or less) Lorox L - 0.9 L/ac+Atrazine 80W - 0.6 kg/ac, (b) medium organic soils (2-5%) Lorox L - 1.3 L/ac+Atrazine 80W - 0.9 kg/ac. Post-emergence; Lorox L 1.0-1.8 L/ac+oil water emulsion as directed spray. ***Fruit trees:*** single application of 3.6 L/ac Lorox L+surfactant in 160-240 L/ac water. ***Potatoes:*** Pre-emergence (crop) 0.9-1.8 L/ac in 120 L water/ac. ***Shelterbelts:*** single application 1.8 L/ac. ***Fallow:*** Lorox L at 210 mL/ac+MCPA+Sweep at recommended rates.
   Water Volume: 40 L/ac minimum
   Incorporation: Not applicable
   Pressure: 275 kPa
   Nozzles: Do no use flood-jet type.
8. SPRAYING TIPS: Use 50 mesh line strainers and screens. Shake container thoroughly before adding to spray tank. Fruit trees - avoid contact with fruit, foliage, and green bark with spray or drift as injury may result.
9. HOW IT WORKS: A systemic herbicide absorbed by leaves and roots. Yellowing (chlorosis), stunting and finally death occurs 10-14 days after treatment.
10. EXPECTED RESULTS: ***Weeds:*** Yellowing starts 7-10 days after application. Effect greatest under excellent growing conditions. Weed control will vary depending on species, time of application and growing conditions. ***Crop:*** A slight yellowing of crop and leaf tip and leaf margin burn may be seen 7-10 days after application. Crop recovers within 14-18 days. Crop injury can occur if applied during period of high heat.
11. EFFECTS OF RAINFALL: Heavy rainfall within 2 hours may decrease activity. Pre-emergent treatment requires rainfall or irrigation for activation.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: 25% carryover into next growing season if rates are 1.8 L/ac or higher. Do not feed or graze green material.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,500). Very toxic to fish; non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Lorox L - Store in a heated area. Do not freeze as settling may occur. If frozen, thoroughly mix to resuspend.

MATAVEN (flamprop-methyl)
Ciba-Geigy

1. FORMULATIONS: Emulsifiable concentrate, 84 g/L; 2X10 L container.
2. REGISTERED MIXES: Mataven + Glean (Wheat only) Mixing instructions: With agitator running add Glean to 1/2 the required amount of water, some more water, then Mataven, then the remainder of water. Ensure that Glean is completely in suspension before adding Mataven. Mataven only: add Mataven to 1/2 of water required, agitate, then add rest of water.
3. CROPS:

canary grass (8.7)	***Forage crops grown for***	fescue, creeping red (9.0)	trefoil, bird's-foot
triticale	***seed production only***	fescue, meadow (8.5)	wheatgrass, crested (8.3)
wheat (durum, winter,	alfalfa (8.3)	milk vetch, cicer	wheatgrass, intermediate (9.0)
spring)(except Selkirk)(8.9)	bromegrass (8.6)	ryegrass, Russian wild (8.7)	
sunflower	clover, red	sainfoin	

4. WEEDS CONTROLLED: Wild oats (8.0)
5. WEEDS SUPPRESSED: None
6. WHEN USED: 3 leaf to shot blade stage of wild oats; wild oats at 2 leaf stage and younger may escape control and may grow to maturity. Do not apply beyond 6 leaf stage of the crop. Apply tank mix when wild oats in 3-4 leaf stage.
7. HOW TO APPLY:
   With: Aircraft or ground equipment. Do not apply Mataven + Glean tank mix by air.
   Rate: 2 L/ac or 2-3 L/ac with grass forage crops using the high rate when forage crops are grown without a companion crop and the low rate when grown with wheat as a companion crop. 2.0 L/ac Mataven + 6-12 g/ac Glean (wheat only).
   Water Volume: Aircraft - minimum - 8 L/ac; Ground - 40 L/ac.
   Pressure: 300 kPa (ground).
8. SPRAYING TIPS:
   (a) Best results will be obtained when the majority of wild oats are at the 3-4 leaf stage, but before the shot blade stage.
   (b) Allow 4-day interval between the application of Mataven and the use of MCPA, Torch, Blagal, Buctril M or Brominal M and an interval of 7 days with the use of 2,4-D or Banvel formulations.
   (c) The 40 L/ac spray volume will provide better control of wild oats, especially where there is a heavy crop canopy or dense growth of wild oats.
   (d) Direct spray pattern 45° forward to enhance spray penetration.
   (e) Agitation required to re-emulsify spray if allowed to stand for several hours.
9. HOW IT WORKS: A systemic herbicide absorbed through leaves and translocated to the growing point. Cell elongation is inhibited and cell initiation and division is impaired. The wild oat is killed, or stunted so that it is unable to compete with crop.
10. EXPECTED RESULTS: Initially a dark blue-green color appears 10 days after spraying then the wild oats turn yellow and brown. Wild oats in the 1-2 leaf stage at application may often appear controlled but may escape and grow to maturity. Will be small, stunted plants with few shrivelled seeds.
11. EFFECTS OF RAINFALL: Rainfall within 2 hours of application will reduce effectiveness.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Drift potential is low. Oats would be the most seriously affected crop. ***Grazing Restrictions:*** Do not graze treated areas. ***Crop Use After Hail:*** Do not graze or feed to livestock. ***Succeeding Crops:*** No restrictions.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (5,000). Eye irritant Non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) plus goggles when handling this product. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: Heated storage is recommended. If frozen, warm and agitate to resuspend.

MCPA (amine, ester, salts)

Numerous Trade Names

1. FORMULATIONS: MCPA amine - 500 g/L; MCPA ester - 500 g/L; MCPA Potassium salt - 400 mL; MCPA Sodium salt - 300 g/L in 20 L containers. Phenoxylene Plus - 250 g/L as sodium and potassium salts - 20 L container.
2. REGISTERED MIXES:
   (a) MCPA amine + Afolan F, Banvel, Lexone, Lorox L, Pardner, Sencor, Sweep, TCA, Torch
   (b) MCPA ester + Avenge, Pardner, Sweep, Torch
   (c) MCPA Potassium Salt + Banvel
   (d) MCPA Sodium Salt + TCA
   (e) Some formulations can be mixed with liquid fertilizers (28-0-0).
   Mixing restrictions: Insure that the proper formulation of MCPA is used with the product considered for mixing.
3. CROPS:

MCPA amine	MCPA ester	MCPA K-Salt	MCPA Na-Salt
hard red spring (8.7), durum, winter wheat; barley (8.7); oats (9.0); fall rye; flax (8.5); asparagus; peas (field and processing); pastures; non-cropland	hard red spring (8.7), winter wheat; barley (8.0); oats (9); rye; flax; pastures; non-cropland	Wheat; barley; oats; flax; rye; field corn	wheat; barley; oats; flax; rye; asparagus; peas; pasture; non-cropland

Underseeding: Not recommended

4. WEEDS CONTROLLED:

MCPA amine	MCPA ester	MCPA K-Salt	MCPA Na-Salt
American dragonhead; biennial wormwood; bluebur; cocklebur; common burdock; flixweed; goat's-beard; goosefoot; hairy galinsoga; lamb's-quarter; mustard (ball, dog, hare's-ear, tumble, wild, wormseed); peppergrass, common; pigweed (redroot, Russian); purslane; ragweed, common; stinkweed; thyme-leaved spurge	lamb's-quarters (8.5); mustard (ball, hare's-ear, tumble, wild, wormseed); ragweed, common; stinkweed (8.3)	lamb's-quarters (8.5); mustard (ball, hare's-ear, wild, wormseed); ragweed, common; stinkweed (8.3)	Same as for potassium

5. WEEDS SUPPRESSED:

MCPA amine	MCPA ester	MCPA K-Salt	MCPA Na-Salt
Annual smartweed (4.9); buckwheat (Tartary (4.3), wild (4.7); Canada thistle; hemp-nettle (5.8); knapweed, Russian; leafy spurge; plantain, common; shepherd's-purse; sow-thistle (annual, perennial); wild radish	same as amine and pigweed (redroot, Russian)	bluebur plus weeds shown under MCPA amine and ester	Same as for potassium

6. WHEN USED:

Crop	MCPA amine	MCPA ester	MCPA K-Salt	MCPA Na-Salt
barley; oats; spring wheat; winter wheat; fall rye	4 leaf to just before flag leaf stage Before crop tillering in the spring	4 leaf to just before flag leaf stage Before crop tillering in the spring	2-6 leaf stage Not recommended	4 leaf to just before flag leaf stage Before crop tillering in the spring
flax		From 5 cm to just before bud formation	5-10 cm high	From 5 cm height to just before bud formation
peas	When crop is 10-18 cm high	Not recommended	Not recommended	When crop is 10-18 cm high
asparagus	Following cultivation just before first spears appear. May repeat at end of cutting season	Not recommended	Not recommended	Following cultivation just before first spears appear. May repeat at end of cutting season
pastures		Before growth of legumes and grasses begins in the spring	Not recommended	Before growth of legumes and grasses begins in the spring

7. HOW TO APPLY:
With: Ground equipment or aircraft
Rate:

Crop	MCPA amine	MCPA ester	MCPA K-Salt	MCPA Na-Salt
wheat; oats; barley; rye; flax;	280-700 mL/ac*	280-700 mL/ac	600-800 mL/ac	490 mL-1.1 L/ac
fall rye; winter wheat; peas;	280-700 mL/ac 280 mL/ac	280-700 mL/ac -	- -	490 mL-1.1 L/ac 600 mL/ac
pastures; non-cropland	450-800 mL/ac	450-800 mL/ac	-	710 mL-1.3 L/ac
Asparagus	1.4 L/ac	-	-	-

***When using MCPA (amine) on cereals underseeded with legumes use 280 mL/ac.**

Mixture Rates: MCPA ester up to 450 L/ac + Avenge 1.4 or 1.7 L/ac. MCPA ester 230 mL/ac + Torch 490-610 mL/ac + Avenge 200C 1.4 or 1.7 L/ac.
Water Volume: Aircraft - minimum 8 L/ac. Ground equipment - 40 L for all crops except peas. On peas apply amine in a minimum of 70 L/ac or Na salt in a minimum of 60 L/ac.
Pressure: 275 kPa

8. SPRAYING TIPS: Do not spray when air temperature is above 27°C. Extremely hard water may reduce performance or cause problems in spraying the product.
9. HOW IT WORKS: A systemic herbicide absorbed by leaf and stem surfaces and translocated to the actively growing regions. MCPA disrupts cell division, causing abnormal growth response, thereby affecting respiration and food reserves.
10. EXPECTED RESULTS: ***Weeds:*** Weeds start to twist between 2-20 days after spraying, depending on weather conditions, formulation and weeds. Following the twisting and bending, plants will turn brown and then die. Only emerged weeds will be controlled. ***Crops:*** Yellowing and thinning of the crop may be noticed if higher than recommended rates are used. ***Poor results may occur if:*** extremely hard water is used.
11. EFFECTS OF RAINFALL: Rain within 2 hours of application will decrease activity.
12. MOVEMENT IN SOIL: Readily leached from soil. Longer residual in dry soil.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Danger from drift with amine and salts is lower than from esters. ***Grazing Restrictions:*** Do not graze dairy cattle within 7 days after spraying.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (700). Very toxic to fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to reduce exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SALT AND AMINE FORMULATIONS SWALLOWED - induce vomiting (see page 3). IF ESTER FORMULATIONS SWALLOWED - do NOT induce vomiting. Get medical attention in all cases.
16. STORAGE: If frozen, warm to 5°C and mix well before using.

MECOTURF (mecoprop)
May and Baker

1. FORMULATIONS: Water soluble 150 g/L; 4 and 8 L container.
2. REGISTERED MIXES: None.
3. CROPS: Wheat (spring, durum) (8.3), barley (9.0), oats, lawns and turf. Underseeding: Not recommended
4. WEEDS CONTROLLED: Black medic, buttercup, clover, chickweed (7.6), corn spurry (7.3), dandelion, plantain, cleavers.
5. WEEDS SUPPRESSED: Canada thistle (4.6)
6. WHEN USED: ***Crop:*** 3 leaf to early flag leaf stage. ***Weeds:*** 2-4 leaf stage.
7. HOW TO APPLY:
   With: Ground equipment
   Rate: Cereals - 2.2-2.8 L/ac. Lawns, turf - 2.2-3.4 L/ac
   Water Volume: Cereals - 80-120 L/ac. Lawns, turf - 80-160 L/ac
   Pressure: 300 kPa
8. SPRAYING TIPS:
   (a) Recommended water volume is essential for optimum weed control.
   (b) Cold weather and drought may cause a delay in weed control action.
9. HOW IT WORKS: A systemic herbicide which disrupts the plant's translocation system causing the accumulation of plant food in the shoots and subsequent starvation of the roots.
10. EXPECTED RESULTS: ***Weeds:*** Leaf curling and stem twisting should be visible within 4-5 days after spraying. Weeds should be completely dead within 3-4 weeks of application. ***Crop:*** Deformed heads, missing florets and twisted awns could result if recommendations are not followed or if crop is under stress conditions.
11. EFFECTS OF RAINFALL: Rain within 4-6 hours will reduce effectiveness.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Danger of vapor drift is low. ***Grazing Restrictions:*** Do not graze within 14 days of application. ***Crop Use After Hail:*** No restrictions if 14 days after application. ***Succeeding Crops:*** No restrictions.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,060).
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to reduce exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Store above 0°C. If stored for 1 year or longer, shake well before using.

PARDNER (bromoxynil)

May and Baker

WARNING POISON

1. FORMULATIONS: Emulsifiable Concentrate; 280 g/L, 8 L
2. REGISTERED MIXES: Avenge alone and with MCPA ester, 2,4-D (amine or ester), MCPA (amine or ester), Hoe-Grass 284, MCPA-K, Roundup, Atrazine, TCA. ***Mixing restrictions:*** Add amine 2,4-D; MCPA; MCPA-K or Atrazine to water first and then add Pardner. Do not use oil or surfactant when mixing Atrazine.
3. CROPS:

barley (9.0)	triticale (8.9)	***Seedling grasses***	reed canary grass
canary grass (9.0)	wheat, durum (8.9)	***grown for seed***	Russian wild rye (9.0)
corn, field (9.0)	wheat, spring (8.9)	bromegrass	wheatgrass (8.5)
corn, sweet (7.9)	wheat, winter	fescue, meadow (8.3)	(crested, intermediate,
flax (8.6)	zero till	orchard grass (8.9)	slender, tall)

   Underseeding to legumes not recommended.

4. WEEDS CONTROLLED:

buckwheat	cow cockle (7.0)	lamb's-quarters (8.4)	smartweeds, annual (8.1)
(Tartary, wild)(8.4)	groundsel, common (9.0)	mustard, wild (8.5)	stinkweed (8.4)
catchfly, night-flowering (7.6)	knawel (7.7)	pigweed, redroot (7.9)	thistle, Russian (8.4)
chamomile, scentless (8.7)	kochia (8.2)		

5. WEEDS SUPPRESSED: None
6. WHEN USED: ***Weeds:*** Seedling to 4 leaf stage except Russian thistle to 5 cm tall. Generally best results if weeds are in seedling stage. ***Crops:*** Wheat, barley, oats, triticale - 2 leaf to early flag leaf. Use tank mix with 2,4-D on wheat or barley after 4 leaf. Winter wheat, fall rye - first growth to early flag leaf. Winter wheat - fall 2-4 leaf. Corn - used alone or with atrazine - until crop is 25 cm tall, then use alone with drop pipes. Flax when 5-10 cm tall. Canary seed grass - 3-5 leaf. Seedling grasses, grown for seed - 2-4 leaf.
7. HOW TO APPLY: Ground equipment. Spra-coupes - not recommended.
   Rate: Wheat, barley, oats, corn (field, sweet), canary seed, triticale 400-500 mL/ac. Flax, fall rye, seedling grasses (grown for seed) - 400 mL/ac.
   Water volume: 40 L/ac; corn - 60 L/ac.
   Incorporation: Not applicable.
   Pressure: 275 kPa
   Nozzles: Flooding type nozzles not recommended.
8. SPRAYING TIPS: To control scentless chamomile and knawel, spray before 3 leaf stage.
9. HOW IT WORKS: Bromoxynil is a contact herbicide so good coverage is essential. Inhibits respiration and photosynthesis causing death.
10. EXPECTED RESULTS: ***Weeds:*** turn brown and die within 3-5 days, more rapidly under good growing conditions and when applied to seedling weeds. ***Poor results can be expected if:*** weeds past 4 leaf stage, poor spray coverage or, lower than recommended rate used. Injury to corn or flax may occur if under stress.
11. EFFECTS OF RAINFALL: None.
12. MOVEMENT IN SOIL: None.
13. GRAZING AND CROPPING RESTRICTIONS: None.
14. TOXICITY: High acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (245). Symptoms of acute poisoning such as stomach cramps, diarrhea, sore throat may appear. Very toxic to fish, snails and slugs.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: Does not require heated storage.

PATORAN (metobromuron)
BASF

1. FORMULATIONS: 50% Wettable Powder, 2.75 kg bag, 670 g/L Flowable, 20 L pail, 400 g/L Flowable, 10 L pail.
2. REGISTERED MIXES: Patoran + Dual Ciba-Geigy 960E
3. CROPS: Potatoes, soy, lima, adzuki, dry and snap beans.
4. WEEDS CONTROLLED:

annual bluegrass	green foxtail	pigweed	smartweeds
barnyard grass	groundsel	purslane	stinkweed.
chickweed	lamb's-quarters	ragweed	
corn spurry	mustard	shepherd's-purse	

5. WEEDS SUPPRESSED: Annual grasses.
6. WHEN USED: Post plant but pre-emergent to crop and weeds. - Patoran can be applied either as:
   (a) A pre-emergent spray in tank mix combination with Dual Ciba-Geigy.
   (b) A pre-emergent spray preceded by a pre-plant incorporated spray of Dual Ciba-Geigy.
7. HOW TO APPLY:
   With: Ground equipment
   Rate:

Crop	50 WP kg/ac	670 FW L/ac	400 FL L/ac
Potatoes	1.3-2.2	1.0-1.7	1.7-3.4
Soybeans	1.3-1.8	1.0-1.3	1.7-2.2
Adzuki beans	1.1-2.0	0.8-1.7	1.7-2.2
Other beans	1.1-2.0	0.8-1.7	1.4-1.7

   Do not use on the bean variety "Slim Green". Use the lower rate for the bean varieties: "Yellow Eye", "Cranberry", "White Kidney", "Light-red Kidney", and "Dark-red Kidney".
   Water Volume: 70-140 L/ac with Patoran 670 FW. 120-160 L/ac with Patoran 50 WP. 100-160 L/ac with Patoran 400 FL.
   Incorporation: Do not soil-incorporate Patoran.
   Pressure: 275 kPa
   Nozzles: Nozzle screens should be 50 mesh size or larger.
8. SPRAYING TIPS:
   (a) Do not let spray tank mixture stand without agitation before use.
   (b) Keep by-pass line on or near the bottom of spray tank to prevent foaming.
   (c) Do not apply Patoran to light textured soils of less than 2% organic matter.
9. HOW IT WORKS: Absorbed through the roots, inhibits photosynthesis.
10. EXPECTED RESULTS: Weed emergence will be inhibited or absent. Under dry conditions, some weed emergence and early die back can occur.
11. EFFECTS OF RAINFALL: Enhance efficacy.
12. MOVEMENT IN SOIL: Patoran can be leached on light soils.
13. GRAZING AND CROPPING RESTRICTIONS: Not applicable.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (5,000). Non-toxic to fish and birds; slightly toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to reduce skin exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for eyes. IF SWALLOWED - induce vomiting (see page 3). Get immediate medical attention.
16. STORAGE: Flowable formulations should be kept in warm storage. If frozen, warm thoroughly then agitate to resuspend.

POAST (sethoxydim)
BASF

1. FORMULATIONS: Emulsifiable concentrate 184 g/L; 2 X 7 L + 1 X 7 L of Assist.
2. REGISTERED MIXES: Poast + Buctril M or Brominal M or Bromox 720 or Sabre. Poast + MCPA (amine or ester). Poast + Bladex (triazine tolerant canola only). Poast + Lontrel, Poast + Torch, Poast + Pardner.
3. CROPS: Canola (including triazine tolerant varieties), flax, soybeans, sugar beets, dry beans, snap beans, dry peas, dry bulb onions, tomatoes, potatoes.
4. WEEDS CONTROLLED:

barley (8.5)	corn (7.0)	oats (volunteer, wild)(8.4)	wheat (8.4)
barnyard, grass (8.6)	foxtail (green, yellow)(8.3)	Persian darnel (8.7)	quackgrass

5. WEEDS SUPPRESSED: Not applicable.
6. WHEN USED: Control weeds in the 1-6 leaf stage but optimum timing is 2-5 leaf (10-15 cm in height).
7. HOW TO APPLY: Assist Oil Concentrate must be added to all applications of Poast.
   With: Ground or air.
   Rate: Green and yellow foxtail, barnyard grass, wild proso millet, Persian darnel - 325 mL/ac. Wild oats - 570 mL/ac; heavy infestations 650 mL/ac. Wheat, oats, barley - 650 mL/ac. For heavy infestations of barley - 770 mL/ac. Quackgrass - 1.78 L/ac. With 810 g/ac of Amsul and 2% Assist Oil Concentrate, rate can be lowered to 1.1 L/ac.
   Water Volume:

Ground Application	Air Application
20-45 L/ac + 200-400 mL/ac Assist	10-20 L/ac + 200-400 mL/ac Assist
45-80 L/ac + 810 mL/ac Assist	

   Pressure: 275-425 kPa
   Nozzles: Flat fan nozzles are optimum. Do not use flood jet or hollow cone nozzles.
8. SPRAYING TIPS:
   (a) Tilt nozzles forward 45° for better coverage.
   (b) Treat when weedy grasses are actively growing, there is good soil moisture and the crop is small enough to permit thorough spray coverage.
   (c) Mixing instructions: With agitator running, fill the spray tank with 1/2 required amount of water. Add Poast, then broadleaf herbicide, if tank mixing. Add Assist Oil Concentrate, then remainder of water.
   (d) Thoroughly clean the sprayer after use by flushing with water and detergent.
   (e) Allow 4 days between the application of Poast and any other chemical.
   (f) Control of grasses growing under drought, flooding or prolonged cool temperatures under 15°C, may be reduced or delayed. Escapes or re-tillering may occur under prolonged stress conditions. DO NOT APPLY ON GRASSES STRESSED LONGER THAN 20 DAYS DUE TO LACK OF MOISTURE AS UNSATISFACTORY CONTROL WILL RESULT.
9. HOW IT WORKS: Absorbed by foliage and translocated to the growing points. Inhibits certain vital metabolic processes in these tissues.
10. EXPECTED RESULTS: Weeds stop growing immediately, gradually turn brown and die within 7-21 days. In wide row crops, cultivation may be necessary to control grasses emerging after treatment. Allow at least 7 days between application and cultivation.
11. EFFECTS OF RAINFALL: Rainfall 1 hour after application will not reduce effectiveness.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: Do not graze treated fields or harvest for feed prior to crop maturity. No restriction on succeeding crops.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = formulation (2,500). Causes moderate skin and eye irritation. Low toxicity to birds, fish and bees. Hazards to the environment are low because of rapid breakdown in soil.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) plus goggles to reduce skin and eye exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention immediately for eyes. IF SWALLOWED - do NOT induce vomiting. Get immediate medical attention.
16. STORAGE: Store product in a cool, dry place. Freezing will not reduce effectiveness.

PRIMATOL (atrazine)
Ciba-Geigy

1. FORMULATIONS: 80% wettable powder - 25 kg pack, Liquid 500 g/L atrazine - 10 L pack
2. REGISTERED MIXES: Primatol with diuron + simazine, 2,4-D; simazine, paraquat.
3. CROPS: Non-crop land only.
4. WEEDS CONTROLLED: Non-selective.
5. WEEDS SUPPRESSED: Horsetail, milkweed.
6. WHEN USED: April and May OR August to freeze-up. **NOTE:** Spring application can be extended into June, sometimes July, if soil moisture is plentiful, or paraquat is added.
7. HOW TO APPLY:
   With: High volume equipment.
   Rate: 8.9-18.2 L/ac (liquid) or 5.75-11.5 kg/ac (WP)
   Incorporation: See "Soil Sterilants" page 4.
8. SPRAYING TIPS: See "Soil Sterilants" page 4.
9. HOW IT WORKS: Primatol is taken up mainly by roots and to a lesser degree through foliage.
10. EXPECTED RESULTS: Weeds fail to emerge or, die back soon after emergence.
11. EFFECTS OF RAINFALL: Moderate rainfall can enhance performance. Very heavy rainfall on sandy soils can cause leaching and thus a decrease in efficacy.
12. MOVEMENT IN SOIL: Low solubility, low leachability, but there may be some physical movement on sloping ground.
13. GRAZING AND CROPPING RESTRICTIONS: Not applicable.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = active ingredient (3,080). May cause eye irritation. Non-toxic to fish and birds; may be toxic to bees.
15. PRECAUTIONS, FIRST AID: Do not spray on foraging bees. Wear standard protective clothing (see page 2) including goggles. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: In a dry location.

PRIMEXTRA (metolachlor + atrazine)

Ciba-Geigy

1. FORMULATIONS: Flowable - metolachlor - 300 g/L + atrazine - 190 g/L + related active triazines - 10 g/L - 2 X 10 L pack, 1 X 110 L.
2. REGISTERED MIXES: Nitrogen fertilizer solutions may replace all or part of the water carrier. Dry granular phosphate fertilizers may be impregnated with Primextra.
3. CROPS: Corn (field, silage, sweet).
4. WEEDS CONTROLLED:

buckwheat, wild	lamb's-quarters	pigweed (prostrate, redroot)	smartweeds, annual
foxtail (green, yellow)	mustard, wild	purslane	witchgrass
grass, barnyard		ragweed	

5. WEEDS SUPPRESSED: None
6. WHEN USED: Spring applied - pre-plant incorporated or banded. Pre-emergent (under irrigation only).
7. HOW TO APPLY:
   With: Ground equipment
   Rate: 2.6-3.4 L/ac
   Water Volume: 60-120 L/ac
   Incorporation: Broadcast and lightly harrow before planting. Do not exceed 5 cm depth. Band treatment: mount a press wheel ahead of the nozzle to level the band.
   Pressure: 200-300 kPa
8. SPRAYING TIPS:
   (a) Add chemical while filling tank with water - gently agitate while filling, mixing, spraying.
   (b) Use metal filters and screens 50 mesh or larger.
   (c) Dry granular fertilizer may be impregnated for pre-plant, incorporated application.
9. HOW IT WORKS: Absorbed by roots and inhibits photosynthesis.
10. EXPECTED RESULTS: Weeds die at germination or under dry conditions die-back soon after emergence.
11. EFFECT OF RAINFALL: Enhances results.
12. MOVEMENT IN SOIL: Negligible lateral movement.
13. GRAZING AND CROPPING RESTRICTIONS: Follow corn with corn only.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (3,100). May cause severe skin irritation and perhaps eye injury. Low toxicity to fish and birds.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Dry heated storage preferred. If frozen, warm to room temperature and agitate.

PRINCEP (simazine)

Ciba-Geigy

1. FORMULATIONS: Princep Nine-T (water dispersible granule) - 89% simazine + 1% related triazines - 4.5 kg pack.
2. REGISTERED MIXES: None
3. CROPS:

alfalfa, established	blueberries, high bush	pears	tree plantings, forest & Christmas
apples	corn (field, sweet)	raspberries	trefoil, bird's-foot (established)
asparagus	loganberries	shelterbelts	woody ornamentals, established
blackberries	nursery stock	strawberries	

4. WEEDS CONTROLLED: Princep controls both broad-leaf and grassy weeds, including seedling perennial weeds.
5. WEEDS SUPPRESSED: None
6. WHEN USED: Princep should be used prior to or during weed emergence and may be applied in either the spring or fall, prior to freeze-up.
7. HOW TO APPLY:
   With: Ground equipment as standard farm sprayer and a Cyclone spreader or other mechanical applicator when using the granular.
   Rate:
   Princep Nine-T (on established stands only)
   Nursery stock: 1-1.5 kg/ac. Shelterbelts: 2-3 kg/ac (both - fall or spring prior to weed emergence). Christmas tree and woodland plantations: 2-2.8 kg/ac. Alfalfa and Bird's-foot trefoil: 0.45 kg/ac (late fall). Corn 0.6-1 kg/ac (within 3 days of seeding). Asparagus, blackberries and blueberries: 1-1.5 kg/ac. (early spring). Raspberries: 0.8-1 kg/ac. (early spring but not on young shoots). Loganberry: 1.5-2.4 kg/ac. Bearing and non-bearing apples and pears: 1-2 kg/ac (spring - prior to weed emergence).
   Water Volume: 120 L/ac for Princep Nine-T except 200 L/ac for shelterbelts.
   Incorporation: In corn, Princep may be applied 1 week before seeding and incorporated to a depth of 2.5 cm.
   Pressure: 275 kPa
8. SPRAYING TIPS: Princep Nine-T - Gentle agitation required during mixing and spraying. Use nozzle screens of 50 mesh or larger. After any break in the spray application, agitate thoroughly. See "Soil Sterilants" page 4. - For this use.
9. HOW IT WORKS: Princep acts through the roots of germinating weeds and inhibit photosynthesis.
10. EXPECTED RESULTS: Weed free ground.
11. EFFECTS OF RAINFALL: Negligible
12. MOVEMENT IN SOIL: Very little movement is possible on clay soil but on sandy ground with high rainfall some leaching may occur.
13. GRAZING AND CROPPING RESTRICTIONS: Allow 30 days between application and grazing of dairy, beef cattle, and sheep and 60 days between application and cutting for hay. After spraying with Princep Nine-T do not plant any crop in the treated area in the same year except corn.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (5,000). May be irritating to eyes and cause dermatitis.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles when using. IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in dry area, heating not required.

REGLONE (diquat)

Chipman

1. FORMULATIONS: Water soluble solution, 200 g/L; 5 L container.
2. REGISTERED MIXES: Reglone + Agral 90 (surfactant). Mixing with other pesticides: Not recommended
3. CROPS:

alfalfa	clover (red, Dutch, white)	peas	sunflowers, all
beans (red, kidney, white, soy, Adzuki)	flax	potatoes	trefoil, bird's-foot
	mustard	rapeseed	

4. WEEDS CONTROLLED: Non-selective for green vegetation, used for weed control and crop desiccation for harvest.
5. WEEDS SUPPRESSED: Not applicable
6. WHEN USED: For crop desiccation. ***Rapeseed:*** By aircraft when 60-75% of the seeds have turned from green to brown. ***Mustard:*** By aircraft when 75% of the seeds have turned. ***Flaxseed:*** By aircraft when crop has reached 75% ball turn. ***Sunflowers:*** Apply by aircraft at 20-50% moisture. ***Field or Dry Peas:*** By aircraft when the crop is mature. Treatment will not mature peas but will kill green weeds in the crop. ***Potato Vines:*** Spray 2 weeks before harvest, by air or ground. ***Alfalfa, Bird's-foot Trefoil, Red and White Clover grown for Seed:*** By air no more than 7 days prior to harvest. ***Beans (red, white, kidney, soy, adzuki):*** Apply by ground or air when 80-90% of natural leaf defoliation of the bean plants has occurred. Treatment does not mature beans but removes green weeds.
7. HOW TO APPLY:
   With: Aircraft or ground equipment. Booms on ground equipment must be high enough to ensure proper coverage of foliage.
   Rate: ***Rapeseed, Mustard:*** light stands, maturing evenly and fields free from weeds, use 810 mL/ac in 20 L/ac water. Heavy stands on fields which contain weeds, use 1.1 L/ac in 20 L/ac of water. Add Agral 90 at 1 L/1,000 L of spray mixture. Argentine varieties should only be desiccated to facilitate harvest of lodged crops. Losses can occur due to pod drop and shatter from handling, and under unfavorable weather conditions. Polish varieties may be straight combined. ***Sunflowers:*** Apply at 600 mL/ac in 20 L of water. Add Agral 90 at 1 L/1,000 L of spray mixture. ***Flax:*** light stands maturing evenly and field is free from weeds. Use 810 mL/ac in 20 L/ac of water. Heavy or weedy stands, or fields with variation in growth, use 1.1 L/ac in 20 L/ac of clean water. Use Agral 90 at 1 L/1,000 L of spray mixture. ***Peas:*** If green weeds are present use 810-1100 mL/ac in 20 L/ac of water. Use Agral 90 at 1 L/1,000 L of spray mixture. ***Alfalfa, Bird's-foot Trefoil, Red and White Clover Grown for Seed:*** Use 810-1130 mL/ac in 90-180 L/ac of water. Use Agral 90 at 1 L/1,000 L of spray mixture. ***Beans:*** Apply 810 mL/ac where weed infestation is light to moderate. In moderate to heavy weed infestation, use 1.1 L/ac. Use at least 120 L/ac of water. Use Agral 90 at 1 L/1,000 L of spray mixture.
   Water Volume: Aircraft - minimum 8 L/ac; Ground - 100-400 L/ac.
   Pressure: 275-400 kPa
   Ground Speed: 9 km/h
   Nozzles: All types.
8. SPRAYING TIPS:
   (a) Higher spray volumes generally give better results.
   (b) Applications made on cloudy days or just prior to or during periods of darkness will increase effectiveness.
   (c) Muddy water will reduce effectiveness.
9. HOW IT WORKS: Reglone is absorbed by all leaf and stem surfaces, non-systemic. Interferes with photosynthesis.
   WARNING: User must be aware that Reglone speeds up crop maturity. In case of adverse weather (heavy rain, hail or strong winds) the resultant damage to crops may be enhanced.
10. EXPECTED RESULTS: ***Weeds:*** Fast and virtually complete top kill of annual weeds. Yellowing starts within a few hours of application. Desiccation of the plant will continue rapidly till death. ***Crops:*** Leaf kill will occur within a few days of application. Stem fall will take longer depending on the crop, but harvesting should normally commence within 7-14 days.
11. EFFECTS OF RAINFALL: No effect once the spray solution has dried.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: No waiting period after use before straw may be fed to livestock.
14. TOXICITY: Very high acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (230). **Has the potential to cause eye damage, if eyes are constantly exposed.** May cause oral and nasal irritation shortly after use. Does not cause lung damage.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) plus a respirator, goggles and gloves. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for eyes immediately. IF SWALLOWED - induce vomiting (see page 3). Get medical attention immediately.
16. STORAGE: Heated storage is necessary.

RIVAL (trifluralin)

Hoechst

(Cereals)

1. FORMULATIONS: Rival: Emulsifiable concentrate 500 g/L, 9 L: 10% Granular (Rival 10G).
2. REGISTERED MIXES: With Avadex BW, Liquid Fertilizer, and Avadex BW + Liquid Fertilizer.
   Mix Restrictions: Add Rival or Rival + Avadex directly into the liquid fertilizer, mix thoroughly and apply as soon as possible. Agitate until application is complete.
3. CROPS: Wheat (spring and durum), barley.
   Underseeding: Not recommended.
4. WEEDS CONTROLLED: Green and yellow foxtail.
5. WEEDS SUPPRESSED: None
6. WHEN USED: Apply alone or as a tank mix with Avadex BW in the spring after seeding and prior to emergence of wheat or barley.
7. HOW TO APPLY:
   With: Ground Equipment
   Rate: 485 mL/ac on light to medium textured soil. 650 mL/ac on heavy textured soil.
   Water Volume: 40 L/ac
   Incorporation: Incorporate 2-4 cm with 2 cross harrowings with tyne or diamond harrows operated at a speed of at least 9 km/h. Both incorporations should be done within 24 hours of application.
   Pressure: 275 kPa
8. SPRAYING TIPS: Apply only on fields that are trash free or summerfallow fields. Crop must be seeded 5-8 cm deep in a well tilled seedbed to prevent contact between the chemical and the seed.
9. HOW IT WORKS: Acts on both the root and shoot tips as they emerge. Prevents cell division and affected plants die before emergence. If the shoot portion of the plant escapes to the soil surface, lateral or secondary root growth is inhibited causing a slow death since the plant is unable to gather moisture or nutrients.
10. EXPECTED RESULTS: ***Green Foxtail:*** Seeds that germinate below the treated layer will produce plants that will emerge. The secondary root system of plants that form within the treated layer is completely inhibited by trifluralin present in that area. The affected plant dies slowly as crop competition and temperature stress over-tax the rootless plant's ability to take up moisture. ***Crop:*** injury is minimized when seeded to a depth of 5-8 cm.
11. EFFECTS OF RAINFALL: No effect once incorporated into the soil.
12. MOVEMENT IN SOIL: None.
13. GRAZING AND CROPPING RESTRICTIONS: None.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (6,150). In clean water, fish are very sensitive to trifluralin; but in runoff and muddy water, trifluralin binds to the suspended soil particles and large amounts can be tolerated by fish. Non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: Do not store below 0°C. If stored below 0°C, bring the contents to 15°C for 24 hours and shake well before using. Do not store near heat, spark or open flame.
17. SPECIAL USE: Rival 10G only on barley - ***Fall application only.***
    (a) When used: Fall application only: Between September 1 and freeze-up.
    (b) How to Apply: See Rival 10G under Rival - oilseed.
    (c) Rate: Light soils (2-4% O.M.) - 3.4 kg/ac; medium or heavy soils (4-6% O.M.) - 4.5 kg/ac. Medium or heavy soils (6-10% O.M.) - 5.7 kg/ac.
    (d) **Warning:** Do not apply Rival 10G for barley on land treated with trifluralin products since June 1 of the previous year. Do not apply to soils with more than 10% O.M. or less than 2% O.M. Seeding should be done into a warm, moist seedbed. Avoid seeding in cold soil.
    (e) **Caution:** Do not apply to soils subject to erosion.

RIVAL (trifluralin)
Hoechst

(Oilseeds, Special Crops, Vegetable Crops)

1. FORMULATIONS: Emulsifiable concentrate 500 g/L, 9 L. 10% Granular (Rival 10G).

2. REGISTERED MIXES: Rival + Liquid Nitrogen Fertilizer (28-0-0). (Pour directly into liquid fertilizer, mix thoroughly and apply as soon as possible with constant agitation.)

3. CROPS:

Rival		***Transplants***	**Rival 10G**
alfalfa, seeded	flax	broccoli	canola
beans (black-kidney,	lentils*	brussel sprouts	flax
lima, snap, white)	mustard, tame	peppers	lentils*
cabbage (seeded, transplants)	ornamentals**	tomatoes	mustard
canola, traizine tolerant	peas (canning, field)	***Transplanted Shelter Belts****	peas (canning, field)
carrots	soybeans	ash, green	sunflowers
cauliflower (seeded, transplants)	turnips	caragana	
crambe	woody nursery stock,	elm (American, Siberian)	
fababeans	perennials	pine, Scotch	

* Fall application only. **Spring application
Underseeding: Not recommended.

4. WEEDS CONTROLLED:

bromegrass, downy	foxtail (green, yellow)(8.1)	lamb's-quarters (8.0)	purslane
buckwheat, wild (8.3)	grass (annual blue,	oats, wild (7.5)	thistle, Russian (7.9)
chickweed (7.1)	barnyard (8.3)	Persian darnel	wheatgrass
cow cockle (9.0)	knotweed	pigweed (8.2)	

5. WEEDS SUPPRESSED: None.

6. WHEN USED: ***Spring application:*** cultivate to destroy existing weeds and apply pre-plant. ***Fall application:*** September 1st to freeze-up. Fall incorporation is discouraged where soil drifting is a problem. ***Summer application:*** On summerfallow between June 1st to September 1st. ***Special instructions for Lentils:*** Not recommended for spring application. Both incorporations of Rival or Rival 10G must be done in the fall. Shallowly till and pack the soil in the spring to ensure a firm seedbed and an accurate depth for seeding. ***Special instructions for flax:*** Summer and fall application only.

7. HOW TO APPLY:
With: Ground equipment
Rate: ***Spring Application*** - (a) Rival: 650 mL/ac; on sandy soils less than 6% organic matter. (b) Rival: 890 mL/ac; on medium or heavy textured soils, 6-15% organic matter, and low to medium wild oat infestations. For heavy wild oat infestations apply Rival:1.1 L/ac.
Fall Application - (a) Rival: 890 mL/ac. Rival 10G: 4.5 kg/ac; on sandy soils less than 6% organic matter. (b) Rival: 1.1 L/ac. Rival 10G: 5.7 kg/ac; on medium or heavy textured soils, 6-15% organic matter, and low to medium wild oat infestations. For heavy wild oat infestation apply Rival at 1.4 L/ac or Rival 10G at 6.9 kg/ac.
Summer Application - Between June 1st and September 1st Rival: 1.4 L/ac. Rival 10G: 5.7 kg/ac on light soils; 6.9 kg/ac on medium or heavy soils.
Water Volume: 40 L/ac
Incorporation: First incorporation at a right angle must be done within 24 hours of application. A tandem disc, discer or field (vibra shank) cultivator are recommended for incorporating to 8-10 cm. To get the best mixing action, operate the disc implement at 6-10 km/h and the cultivator at 10-13 km/h. Deep tillage cultivators are not recommended.
Pressure: 275 kPa

8. SPRAYING TIPS: Use on soils with less than 20-25% straw cover. On stubble, chop and thoroughly mix residues and weed growth into the soil before application.
A tandem disc mixes best on stubble or poor condition soils (crusted, lumpy or wet). Fall application should be followed with 2 incorporations at right angles, before freeze-up. This or a summer application should be preceded by a light spring tillage to a 5-8 cm depth before seeding.
Do not apply on soils that are wet, in poor tilth, or contain 15% + organic matter. To avoid concentrating wild oat seeds below the treated layer, do not plow land prior to trifluralin application.

9. HOW IT WORKS: Trifluralin kills seedlings as they germinate. Inhibits cell division in the actively growing points of the root and shoot.

10. EXPECTED RESULTS: ***Weeds:*** Most weeds die before emerging. Weeds will exhibit swelling in the coleoptile region, stubby, thick primary root development and lack of secondary roots, which leads to death due to inadequate moisture obtaining ability. ***Crop:*** Seed flax into a well packed warm moist seedbed. Do not seed deeper than 4 cm.

11. EFFECTS OF RAINFALL: No effect once trifluralin is incorporated into the soil.

12. MOVEMENT IN SOIL: None.

13. GRAZING AND CROPPING RESTRICTIONS: None. ***Crop Use After Hail:*** No restrictions ***Succeeding Crops:*** Normally, trifluralin carry over will not harm crops grown in rotation. As a precaution, oats, sugar beets and small seeded annual

grasses should not be grown in rotation following a trifluralin treated crop. Alfalfa and most clovers are tolerant to trifluralin. Drought conditions in the year of treatment may result in higher levels of trifluralin carry-over into the next year. To avoid wheat injury, seed less than 7 cm deep into a warm moist seedbed.

14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (75,000). In clean water, fish are very sensitive to trifluralin, but in run off or muddy water, it binds to soil particles and large amounts can be tolerated by fish. Non-toxic to bees.

15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.

16. STORAGE: Do not store below 0°C. If stored below 0°C, bring the contents to 15°C for 24 hours and shake well before using. Do not store near heat, spark or open flame.

ROUNDUP (glyphosate)
Monsanto

1. FORMULATIONS: Water soluble solution 356 g/L; 1, 4 or 10 L container.
2. REGISTERED MIXES: ***Zero Till:*** Roundup + Torch + registered non-ionic surfactant. ***Chemical Fallow:*** Roundup + 2,4-D amine (or Banvel or Torch) + registered non-ionic surfactant. Mixing with other pesticides: Not recommended
3. CROPS: A non-selective herbicide used for pre-plant, pre-emergence or for spot application in certain crops.
4. WEEDS CONTROLLED:

Annuals		***Perennials***	***Deciduous brush***
bluegrass, annual (9.0)	mustard	bindweed, field (7.2)	birch
bromegrass, downy	oats, wild	bluegrass (Canada,	poplar
buckwheat, wild (6.7)	ragweed	Kentucky)(9.0)	raspberry
foxtail, green (7.9)	shepherd's-purse	bromegrass, smooth	snowberry
knotweed	smartweeds, annual	cattail	willow
kochia	sow-thistle	cress, hoary	
lamb's-quarters	thistle, Russian	curled dock	
lettuce, prickly.	vetch	milkweed	
		quackgrass	
		sow-thistle, perennial	
		thistle, Canada (7.8)	
		toadflax (8.5)	
		wormwood	

5. WEEDS SUPPRESSED: Many
6. WHEN USED: Canada thistle must be 20-25 cm + in height and up to the early heading or bud stage or in the fall rosette stage. Quackgrass - 8-10 cm in height. Other perennials at the early head or early bud stage. The low rate controls annual weeds 6-7 cm in height. Apply to deciduous brush in June, July, and August. Registered mixes are recommended for controlling annual weeds in chemical-fallow or zero-till situations.
7. HOW TO APPLY:
   With: Ground equipment only. **Do not use in galvanized steel or unlined steel tanks.**
   Rate: Perennial weeds: ***Bindweed (field)*** – 2.8-4.9 L/ac ***Canada thistle*** – 1.9-2.8 L/ac ***Canada thistle (rosette stage)*** – 1.0 L/ac in the fall after summerfallow ***Milkweed (common)*** – 4.9 L/ac ***Quackgrass*** – 1.9-2.8 L/ac ***Quackgrass (fall only)*** – Post-harvest when regrowth has 3-4 leaves - 1.0 L/ac ***Other perennials*** – 2.8-4.9 L/ac ***Annual Broadleaf:*** 900-1400 mL/ac ***Annual Grasses:*** 300-400 mL/ac ***Brush:*** 4 L/ac ***Minimum or zero tillage systems:*** 450-575 mL/ac
   Water Volume: Handgun and high volume equipment - use coarse sprays only at 80-120 L/ac. Boom equipment - 40-120 L/ac Chemical Fallow and Reduced Rates: 20-40 L/ac
   Pressure: 275 kPa
   Nozzles: Flat fan nozzles for volumes 20-40 L/ac - flood jet type or flat fan for volumes above 40 L/ac
8. SPRAYING TIPS: ***Quackgrass:*** apply 4-6 weeks after swathing. Sod-bound quackgrass may require follow-up treatment. Frost of -5°C will be tolerated by new shoots. Frost damage to growing shoots could reduce control and the field should be left untilled for spring treatment. Frost damage is evident by the drying of new shoots shortly after the frost. Apply in spring or fall to quackgrass that is in the 3-4 leaf stage (8-10 cm of new growth) for season long control - use 1 L/ac. ***Canada thistle (rosette stage):*** (15 cm in diameter or 5 weeks old) in the fall on summerfallow using 1 L/ac. Allow 5 or more days after application before tillage.
9. HOW IT WORKS: Roundup is a systemic herbicide which moves from the foliage into the roots and kills the entire plant.
10. EXPECTED RESULTS: Wilting and yellowing of annual weeds occur within 2-4 days, perennial weeds require 7-10 days. Complete browning of above ground growth and deterioration of roots occurs. Cool or cloudy weather may slow the activity and delay visual effects.
11. EFFECTS OF RAINFALL: Rainfall within 6 hours after application may reduce effectiveness. Heavy rainfall within 2 hours after application may wash the chemical off the foliage and require retreatment.
12. MOVEMENT IN SOIL: Not applicable
13. GRAZING AND CROPPING RESTRICTIONS: Not applicable.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (4,320). Eye irritant. Non-toxic to birds, fish and bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles to reduce skin and eye exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Heated storage not required.

SABRE - BROMOX 720 (bromoxynil + MCPA)

Union Carbide Pfizer

1. FORMULATIONS: Emulsifiable concentrate - bromoxynil 360 g/L + MCPA 360 g/L. Container size: Sabre - 12.5 L; Bromox 720 - 6.25 L.

2. REGISTERED MIXES: Avenge, MCPA Ester, Poast + Assist.
   Mixing restrictions:
   (a) With MCPA - with agitator running add bromoxynil to 1/2 of the water then add rest of water and MCPA.
   (b) With Avenge - As above, adding Avenge last.
   (c) With Poast - As in (a) adding Sabre or Bromox 720 last.

3. CROPS:
   Spring wheat (8.6), barley (8.8), oats (8.8), flax (8.4), canary seed (8.5), durum wheat, winter wheat, fall rye.
   Underseeding: Not recommended.

4. WEEDS CONTROLLED:

bluebur	flixweed	mustard (8.4)	shepherd's-purse
buckwheat	groundsel, common	(ball, tumble, wild, wormseed)	smartweeds, annual (8.2)
(Tartary, wild (8.1))	hemp-nettle*	night-flowering catchfly	stinkweed (8.9)
chamomile, scentless (7.6)	knawel	pigweed, redroot (7.9)	sunflower, volunteer
cocklebur	kochia (6.7)	ragweed, common	thistle, Russian (7.4)
cow cockle (7.8)	lamb's-quarters (8.6)	rapeseed, volunteer (8.7)	

   * Tank mix with MCPA.

5. WEEDS SUPPRESSED: Canada thistle and perennial sow-thistle.

6. WHEN USED: Cereals; 2 leaf to early flag leaf. Winter wheat, fall rye; after growth begins in spring to early flag leaf. Canary seed; 3-5 leaf. Flax; 5-10 cm.

7. HOW TO APPLY:
   With: Ground equipment or air.
   Rate: 315 mL/ac.
   Water Volume: Ground Equipment: 20 or more L/ac. Air: 8 or more L/ac.
   Pressure: 275 kPa
   Nozzles: No flood tips.

8. SPRAYING TIPS:
   (a) Avoid spraying during a severe drought. Under conditions of high temperature and humidity, slight discolouration of cereals may occur but no effect on crop yields.
   (b) Flax is less tolerant than cereals, therefore do not spray flax in hot humid weather when day time temperatures are over 25-29°C.
   (c) Best results are achieved when weeds are sprayed in seedling stage, with good spray coverage.

9. HOW IT WORKS: Bromoxynil is a contact type herbicide, therefore, good spray coverage is essential. Inhibits photosynthesis and plant respiration. MCPA is absorbed through leaves and is readily translocated in the plant.

10. EXPECTED RESULTS: Small burnt spots on the leaf can appear within hours, complete death takes up to 2 weeks. ***Poor results may be expected if:*** Poor coverage. Poor penetration through crop canopy.

11. EFFECTS OF RAINFALL: No effect.

12. MOVEMENT IN SOIL: Not applicable.

13. GRAZING AND CROPPING RESTRICTIONS: No grazing or crop use restrictions.

14. TOXICITY: High mammalian toxicity; oral LD_{50} rats (mg/kg) = (365). Very toxic to fish and birds; non-toxic to bees

15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - Do NOT induce vomiting. Get medical attention.

16. STORAGE: Does not require heated storage.

SENCOR (metribuzin)

Chemagro

1. FORMULATIONS: 500 Flowable 500 g/L; 5 L jugs, 4 jugs/case. 750 water dispersable granule (sprayule). 750 g active/kg; 3 kg jugs, 4 jugs/case.

2. REGISTERED MIXES: Cereals: Sencor+Banvel; 2,4-D; MCPA amine; or Target. Potatoes: Sencor+Eptam. Fababeans+triazine tolerant Canola: Sencor+Treflan (see Spectrum).

3. CROPS:

alfalfa	canola, triazine tolerant	lentils (7.8)	potatoes (8.6)
barley (8.9)	fababeans (8.6)	peas, field	wheat, spring (8.5)

Underseeding: Do not underseed.

4. WEEDS CONTROLLED:

buckwheat, Tartary (5.3)	groundsel, common	lamb's-quarters (8.4)	smartweed, green (8.5)
catchfly, night-flowering	hemp-nettle (8.4)	mustard (ball, wild, wormseed) (8.0)	stinkweed (8.2)
chickweed (8.1)	henbit (8.0)	pigweed, redroot (7.4)	thistle, Russian (7.2)
corn spurry (7.1)	lady's-thumb	rapeseed, volunteer (non-triazine tolerant)(8.8)	

5. WEEDS SUPPRESSED: Canada thistle and sow-thistle with the 2,4-D, MCPA and Banvel mixes.

6. WHEN USED: ***Wheat and Barley:*** Sencor alone - 2-5 leaf stage. Sencor+Banvel - 2-3 leaf stage of barley, - 2-4 leaf stage of wheat. Sencor+2,4-D amine - 3-5 leaf stage. Sencor+MCPA amine - 3-5 leaf stage. Sencor+Target - Barley - 2-3 leaf stage, Wheat - 2-5 leaf stage. ***Potatoes:*** Sencor alone - before weeds are 4 cm high. Sencor+Eptam - pre-plant incorporated. ***Fababeans:*** Sencor+Treflan - pre-plant incorporated. ***Lentils and Peas:*** Sencor alone - Before vines are 15 cm long and after weeds have emerged but less than 5 cm. Do not use if soil has less than 4% organic matter. ***Alfalfa (Grown under irrigation):*** Sencor - Apply to dormant established stands of alfalfa in the fall. Injury may occur to alfalfa if Sencor is applied earlier than 18 months after seeding. ***Triazine Tolerant Canola:*** Sencor alone - before weeds are 5 cm high. Sencor+Treflan - pre-plant incorporated, fall or spring.

7. HOW TO APPLY: Do not tank mix with any other pesticide, wetting agent or surfactant. Do not apply within 3 days after periods of cool, wet or cloudy weather, else crop injury may occur. Do not apply more than once per season. Crops, with the exception of triazine tolerant canola, must be planted at least 5 cm below the soil surface.
With: Ground equipment
Rate: ***Barley:*** 110-225 mL/ac of 500 flowable alone or tank-mixed with 350-440 mL/ac of MCPA or 2,4-D amine 500 or tank-mixed at 110-170 mL/ac of Sencor with 110 mL/ac of Banvel 400 or tank mixed at 400-600 mL/ac of Target. **Klondike, Leduc, and Johnston barley:** 110-170 mL/ac of 500 F or 110 mL/ac of 500 F tank-mixed with MCPA amine. Do not apply Sencor plus Banvel; 2,4-D or Target. ***Wheat:*** 110-170 mL/ac of 500 F alone or tank-mixed with 345-440 mL/ac of MCPA or 2,4-D amine 500 or tank-mixed with 110 mL/ac of Banvel 400 or tank mixed with 400-600 mL/ac of Target. ***Lentils:*** 170 mL/ac of 500 F applied as a post-emergence broadcast spray in at least 70 L/ac of water. ***Peas:*** 170-225 mL/ac of 500 F applied as a post-emergence broadcast spray in at least 70 L/ac of water. ***Potatoes:*** 225 mL/ac of 500 F applied early post-emergence. Under irrigation, 225-910 mL/ac (maximum) applied early post-emergence. Irrigation or dryland, 225-345 mL/ac (maximum) of 500 F tank-mixed with 1.7-2.2 L/ac of Eptam 800 as a pre-plant incorporated treatment. ***Fababeans:*** Spring Application, 325-345 mL/ac of 500 F tank-mixed with 600-800 mL/ac of Treflan 545 EC as a pre-plant incorporated treatment. Fall Application, 345 mL/ac of 500 F tank-mixed with 800-1050 mL/ac of Treflan 545 EC as a pre-plant incorporated treatment. ***Alfalfa (Under irrigation only):*** 910 mL/ac of 500 F as a dormant fall application. ***Triazine Tolerant Canola:*** 170 mL/ac of 500 F applied as a post-emergent broadcast spray in at least 70 L/ac of water. Spring Application, on light soils, with less than 6% O.M., 175-225 mL/ac of 500 F+600 mL/ac of Treflan. On medium or heavy soils, 6-15% O.M., 225-345 mL/ac of 500 F+800-1100 mL/ac of Treflan 545 EC as a pre-plant incorporated treatment. Fall Application, on light soils, with less than 6% O.M., 225-285 mL/ac of 500 F+800 mL/ac of Treflan. On medium or heavy soils, 6-15% O.M., 285-345 mL/ac of 500 F+1.1-1.3 L/ac of Treflan 545 EC as a pre-plant incorporated treatment.
Water Volume: 40 L/ac - except 70 L/ac for lentils, peas and post emergent on triazine tolerant canola.
Incorporation: For Sencor+Eptam on potatoes refer to Eptam. For Sencor+Treflan on fababeans and triazine tolerant canola refer to Treflan and Spectrum.
Pressure: 200-275 kPa

8. SPRAYING TIPS: Shake container thoroughly before adding to sprayer tank. Allow a 4-5 day interval between the application of Sencor and post-emergent wild oat herbicides. Weed control may be reduced if Sencor is applied later than the 5 leaf stage of crop. Allow 4-5 days after frost for crop to recover before applying Sencor. Crop may be sprayed when wet with dew. Lentils and Peas - apply only once per crop season. Crop must be planted at least 5 cm below the soil surface. Tilt nozzles 45° forward for better spray penetration.

9. HOW IT WORKS: A systemic herbicide absorbed by leaves and roots and translocated to new growth. Inhibits photosynthesis and the weed turns brown and dies.

10. EXPECTED RESULTS: ***Broad-leaf Weeds:*** Initial yellowing 5-7 days after application, weeds turn brown and die within 14-16 days. Sencor is active in the soil for a short period and can control new shallow-rooted germinants, like chickweed. ***Crop:*** Under certain environmental conditions, like extremely hot weather or frost that occurs within 1-2 days of application, the crop will show some yellowing and slight reduction in height. Discolouration disappears in 7-10 days. On Klondike, Johnston

and Leduc barley varieties, temporary lightening in crop colour and reduction in crop height may occur. Lentils and peas provide little competition against weed growth due to their low growth habit. Under heavy weed infestations or lush growth, control may be poor.

11. EFFECTS OF RAINFALL: Rainfall within 6 hours after application may reduce weed control.
12. MOVEMENT IN SOIL: Little leaching occurs in soils with high organic matter.
13. GRAZING AND CROPPING RESTRICTIONS: Do not graze or feed treated crop to livestock within 30 days of application (lentils and peas - 70 days) ***Crops:*** Do not harvest for grain within 60 days of application (lentils and peas - 70 days, canola - 75 days).
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,100). Slightly toxic to fish and birds.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) when working with the product to avoid exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: No damage by freezing but avoid large temperature fluctuations. Store in a cool dry place.

SIMMAPRIM (simazine)
Ciba-Geigy

1. FORMULATIONS: Wettable powder - 80% - 25 kg pack.
2. REGISTERED MIXES: Simmaprim with amitrol, atrizine, atrizine + diuron, paraquat, sodium chlorate, and sodium metaborate.
3. CROPS: Total weed control and bare ground maintenance on non-crop land.
4. WEEDS CONTROLLED: Most annual and perennial broad-leaf weeds and grasses. Horsetail, milkweed and sedges may require more than 1 treatment.
5. WEEDS SUPPRESSED: Not applicable
6. WHEN USED: Apply before or during weed emergence. Can be applied in fall before freeze up for control of perennial weeds.
7. HOW TO APPLY:
   With: High volume application equipment.
   Rate: 5.7-11.5 kg/ac
   Incorporation: See "Soil Sterilants" page 4.
8. SPRAYING TIPS: See "Soil Sterilants" page 4.
9. HOW IT WORKS: Absorbed through roots only.
10. EXPECTED RESULTS: Failure of weeds to emerge or, depending on weather conditions, weeds may die back after emergence.
11. EFFECTS OF RAINFALL: Average rainfall can enhance performance.
12. MOVEMENT IN SOIL: Movement in the soil is negligible.
13. GRAZING AND CROPPING RESTRICTIONS: Not applicable - for use on non-crop land.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (5,000). May be irritating to eyes and cause dermatitis.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) and goggles to reduce skin and eye exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in dry area. Heating not required.

SINBAR (terbacil)
DuPont

1. FORMULATIONS: Wettable powder - 80% - 2 kg pack.
2. REGISTERED MIXES: None.
3. CROPS: Alfalfa (forage and seed) (8.6). After crop established for 1 growing season.
4. WEEDS CONTROLLED:

barley, wild (7.5)	foxtail, green (7.3)	lettuce, prickly	ryegrass, perennial
bluegrass, annual (8.6)	grass, barnyard (7.2)	mustard, wild	shepherd's-purse (9.0)
brome, downy	henbit	pigweed, redroot (8.0)	stinkweed (9.0)
chickweed, common (8.6)	lamb's-quarters (8.9)	ragweed, common	thistle, annual sow (8.4)
dandelion (8.5)			

5. WEEDS SUPPRESSED: Dandelion (less than 2 years old), quackgrass
6. WHEN USED: Preferably after alfalfa becomes dormant in fall or before growth begins in spring.
7. HOW TO APPLY:
   With: Ground equipment.
   Rate: 285-610 g/ac - lower rate on light soils, higher rate on heavier soils.
   Water Volume: 80 L/ac
   Incorporation: Not applicable.
   Pressure: 275 kPa
8. SPRAYING TIPS:
   (a) Use metal filters, line strainers and screens no finer than 50 mesh.
   (b) Continuous tank agitation required.
   (c) To reduce crop injury, do not use on soils with less than 1% organic matter.
9. HOW IT WORKS: Absorbed by roots and inhibits photosynthesis.
10. EXPECTED RESULTS: ***Weeds:*** Kills germinating weeds. Any that emerge will yellow and die. ***Crop:*** No effect on alfalfa if it is dormant at time of application. ***Poor results may be expected if:*** Too little moisture for activation, uneven coverage, rate too low for soil type.
11. EFFECT OF RAINFALL: Moderate rainfall is desirable.
12. MOVEMENT IN SOIL: Some movement under light soil and high moisture conditions.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Most crops sensitive. ***Succeeding Crops:*** Seed no crop within 2 years of last treatment.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rate (mg/kg) = (5,000). Non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Cool, dry storage.

SODIUM TCA
Hoechst

1. FORUMLATION: 85% granule in 25 kg bags. 500 g/L, 20 L.
2. REGISTERED MIXES: Sodium TCA + 2,4-D amine; MCPA amine; MCPA sodium salt; Buctril M.
3. CROPS:

barley (9.0)	cabbage	flax (8.6)	oats
beets, red	canola (8.7)	non-crop land	peas, field (7.0)
beets, sugar	cauliflower		

4. WEEDS CONTROLLED: Green foxtail (6.9), yellow foxtail (6.9), spruce, balsam, fir, pine.
5. WEEDS SUPPRESSED: Quackgrass, Kentucky blue, smooth bromegrass.
6. WHEN USED: Foxtail - 1-3 leaf stage; Quackgrass - no stage limitation. Oats, barley, canola, flax - 2-4 leaf. Field peas - 10-20 cm tall. Sugar beets - pre or post-emergent before 4 leaf. Red beets - pre-emergent. Cabbage and cauliflower - pre-emergent or directed post-emergent. Flax - 10-15 cm tall.
7. HOW TO APPLY:
   With: Ground equipment
   Rate: ***Flax, rapeseed, field peas:*** 1.8 kg/ac, 3.1 L/ac. ***Barley:*** 500 g/ac, 870 mL/ac in 32-40 L/ac of water. ***Oats:*** 500 g/ac - 1.1 kg/ac, 0.87-1.9 L/ac in 32-40 L/ac of water. ***Sugar beets:*** 1.8 kg/ac, 3.1 L/ac post-emergent, - 2.5-4 kg/ac, 2.3-6.9 L/ac pre-emergent, in 40-80 L/ac water. ***Red beets:*** 2.5-4 kg/ac, 2.3-6.9 L/ac.
   Non-Selective: ***Quackgrass:*** 44.5 kg/ac, 75.7 L/ac. ***Quackgrass patches (undisturbed):*** 100-125 g/10 m², 0.2-2.1 L/10 m² ***Quackgrass patches (with cultivation):*** 75-100 g/10 m², 130-150 mL/10 m² ***Kentucky blue, smooth bromegrass suppression:*** 5-7 kg/ac, 8.6-12.1 L/ac ***Spruce, balsam fir, pine:*** 20-25 kg/1000 L of water, 13.8-16.2 L/ac ***Pavement maintenance:*** 2.5 kg/100 m², 4.25 L/100 m²
   Water Volume: 40-60 L/ac in all cases except for woody plant control. Apply to point of run-off for spruce, fir and pines.
   Incorporation: For quackgrass cultivate or disc thoroughly after application.
   Pressure: 275 kPa
   Nozzles: Flat fan nozzles, use minimum 50 mesh screens.
8. SPRAYING TIPS:
   (a) Flush sprayer thoroughly after each use to prevent corrosion.
   (b) Agitate to dissolve TCA.
   (c) Stainless steel nozzles are recommended due to corrosiveness.
   (d) When mixing spray, put 10 L of water in the tank for each kg of TCA.
   (e) Ensure that TCA is dissolved before adding another herbicide.
   (f) Plant barley and oats at least 5 cm deep to avoid crop injury.
9. HOW IT WORKS: Absorbed more readily through roots than foliage. Precipitates proteins in the plants and disrupts the membranes.
10. EXPECTED RESULTS: Leaves die and plant dries up. Chlorosis, then browning of the leaf tips, growth retardation and eventual death. ***Poor results may be expected if:*** the soil is dry at application time and for a 2-3 week period after or there is inadequate mixing.
11. EFFECTS OF RAINFALL: A light rain after application is beneficial for activation. Heavy rain may wash TCA off foliage.
12. MOVEMENT IN SOIL: Movement is greater in light, sandy soils.
13. GRAZING AND CROPPING RESTRICTIONS: ***Grazing restrictions:*** Do not feed tops of sugar or red beets to livestock. Do not allow animals to graze treated areas. Do not contaminate water bodies.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (3,320). Skin and eye irritant. Non-toxic to birds and fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) plus goggles and gloves to reduce exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention.
16. STORAGE: Dry storage, no effect from freezing. A minimum of 2 years shelf life.

SPECTRUM (metribuzin + trifluralin tank mix)

Chemagro/Elanco

1. FORMULATIONS: One 4.8 L jug of Sencor 500 F flowable 500 g/L packed with two 8.5 L jugs of Treflan 545 EC emulfiable concentrate 545 g/L for tank mixing.
2. REGISTERED MIXES: Sencor 500 F + Treflan 545 EC.
3. CROPS: Triazine Tolerant Canola (8.4). NON-TRIAZINE TOLERANT RAPESEED WILL BE KILLED BY THIS COMBINATION. Do not underseed.
4. WEEDS CONTROLLED:

bluegrass, annual	darnel, Persian	lady's-thumb (6.7)	rapeseed, volunteer
brome, downy	foxtail (green (8.5), yellow)	lamb's-quarters (8.0)	(non-triazine tolerant (6.9))
bromegrass	grass, barnyard	mustard, wild (7.6)	shepherd's-purse
buckwheat, wild (7.4)	hemp-nettle (8.9)	oats, wild	smartweed, green (8.7)
chickweed	knotweed	pigweed, redroot	stinkweed (8.7)
cow cockle		purslane	thistle, Russian

5. WEEDS SUPPRESSED: None.
6. WHEN USED: ***Spring application:*** cultivate to destroy existing weeds and apply prior to planting crop in the spring. ***Fall application:*** apply in the fall (September 1 to freeze-up). **NOTE:** Fall incorporation should be discouraged wherever soil drifting is a problem.
7. HOW TO APPLY: With ground equipment.
Rate:

Soil Characteristics	Spring Application Treflan 545 EC + Sencor 500 F	Fall Application Treflan 545 EC + Sencor 500 F
Light textured soils		
2-3% Organic matter	600 mL/ac + 175 mL/ac	800 mL/ac + 225 mL/ac
3-6% Organic matter	600 mL/ac + 225 mL/ac	800 mL/ac + 285 mL/ac
Medium or heavy textured soils		
6-10% Organic matter	800-1100 mL/ac* + 225-350 mL/ac	1.1-1.3 L/ac** + 285-350 mL/ac
10-15% Organic matter	800-1100 mL/ac* + 350 mL/ac	1.1-1.3 L/ac** + 350 mL/ac

* Use the 1.1 L/ac rate of Treflan 545 EC when there is a heavy wild oat infestation.
** Use the 1.3 L/ac rate of Treflan 545 EC when there is a heavy wild oat infestation.
NOTE: Mix the Sencor in the tank before adding the Treflan. Continually agitate until all the mixture is sprayed. Do not allow the sprayer to stand without agitation.
Water Volume: Minimum of 40 L/ac
Incorporation: Apply to the soil and incorporate in the same operation, if possible. Must be incorporated within 24 hours after application. Work twice in different directions. Use a tandem disc, discer or vibrashank type cultivator to cut 8-10 cm deep. Operate disc implements at 7-10 km/h and cultivators at 10-13 km/h.
Pressure: 275 kPa
8. SPRAYING TIPS:
(a) Cultivate to destroy existing weeds before application. When applying to stubble fields, chop and thoroughly mix crop residues into soil to a depth of 10-15 cm. Disc type implements provide the best results. To avoid concentrating wild oat seeds below the treated layer, and causing soil erosion, do not plow (moldboard) land prior to application.
(b) Do not use on soils with less than 2% or more than 15% organic matter. On variable soils with light sandy areas, some injury may occur on the sandy areas if the rate used is for the heavier soil type. On soils with 10% organic matter and higher, broadleaf weed control may not be adequate. Do not apply to wet soils or soils subjected to periods of flooding. Do not incorporate with a field cultivator when the soil is crusted, lumpy or too wet for good mixing action.
(c) Triazine Tolerant Canola is sensitive to deep seeding so seedbed should be shallowly tilled and packed just prior to seeding in the spring to ensure a firm seedbed and accurate depth of planting.
9. HOW IT WORKS: See Treflan and Sencor.
10. EXPECTED RESULTS: See Treflan and Sencor. ***Crop:*** Only for Triazine Tolerant canola. Stress such as disease, cold, deep planting, excessive moisture, high salts or drought may weaken canola seedlings and increase the possibility of damage. Temporary lightening on the margins of cotyledons and a slight delay in crop development may occur.
11. EFFECTS OF RAINFALL: Rainfall does not affect Treflan activity once incorporated. Sencor can be leached in sandy soils.
12. MOVEMENT IN SOIL: Treflan is not leached in soil. Sencor can be leached in soils with low clay and/or organic matter.
13. GRAZING AND CROPPING RESTRICTIONS: Do not graze or feed treated crop within 30 days of application. Do not harvest for grain for 75 days after treatment. ***Succeeding Crops:*** Vegetable crops and rapeseed (Non-triazine Tolerant) are sensitive to Sencor and may be injured if planted in Sencor treated soil in the application year and the next. After harvest, tillage that provides thorough mixing of the soil may reduce the chance of injury to succeeding crops. As a precaution oats, sugar beets and small-seeded annual grasses such as timothy, canary seed and creeping red fescue, should not be grown in rotation following a Treflan treated crop. Drought conditions in the year of a Treflan treated crop may result in higher levels of Treflan carry-over into the next year. To reduce wheat injury seed less than 7 cm into warm moist

seedbed.

14. TOXICITY: See Treflan and Sencor.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: See Treflan and Sencor.

SPIKE (tebuthiuron)

Elanco

1. FORMULATIONS: 80% wettable bowder (Spike 80W) - 2 kg bag or 20 kg box (Spike 5G) - 7 kg shakes box or 20 kg drum.
2. REGISTERED MIXES: None
   Mix restrictions: Not applicable
   Mixing with other pesticides: Not recommended
3. CROPS: Non-cropland only.
4. WEEDS CONTROLLED: Total vegetation control.
5. WEEDS SUPPRESSED: Not applicable
6. WHEN USED: Use throughout the growing season and up to September 15th. Best if applied early in spring.
7. HOW TO APPLY:
   (a) Spike 5G
   With: Shaker box or granular spreader.
   Rate: 44.5-91.0 kg/ac. Apply the higher rates for deep-rooted perennials and for greater residual effect.
   Incorporation: See "Soil Sterilants" page 4.
   (b) Spike 80WP
   With: Ground spray equipment
   Rate: 2.2-4.5 kg/ac. Use higher rates for deep rooted perennial weeds, and for longer term weed control.
   Water Volume: See "Soil Sterilants" page 4.
8. SPRAYING TIPS:
   (a) Do not apply where bare ground is undesirable, where soil erosion may be a problem, or on areas where the roots of desirable vegetation may extend.
   (b) Maintain continuous agitation when using Spike 80W.
   (c) If by-pass agitation is used, the return line should terminate at the bottom of the tank to minimize foaming.
   (d) Clean application equipment thoroughly after use.
9. HOW IT WORKS: Requires rainfall to move into root zone. Absorbed by roots and inhibits photosynthesis.
10. EXPECTED RESULTS: Vegetation will turn brown and die. Speed of kill will depend on root depth and amount of rainfall. Duration of control will depend upon the amount of chemical applied, soil-type and environmental conditions. ***Poor results may be expected from:*** inadequate application rate or application onto frozen ground.
11. EFFECTS OF RAINFALL: Rainfall will activate product, by carrying into the root zone.
12. MOVEMENT IN THE SOIL: Once moved into the soil by rainfall, will leach vertically with time.
13. GRAZING AND CROPPING RESTRICTIONS: Spike is non-selective residual herbicide, only used on non-cropland.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (644). Slightly toxic to fish and birds.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in a dry place.

STAMPEDE CM (propanil + MCPA)

Rohm and Haas

1. FORMULATIONS: Emulsifiable concentrate: 360 g/L propanil + 100 g/L low volatile MCPA ester, 11.4 L jug.
2. REGISTERED MIXES: None
3. CROPS: Spring wheat, durum wheat (8.7), barley (8.6), oats (8.9), and flax (8.4), canary seed. Underseeding: Not recommended
4. WEEDS CONTROLLED:
   - bluebur (7.8)
   - buckwheat (Tartary (8.6), wild (8.4))
   - flixweed (7.4)
   - foxtail (green, yellow)(8.6)
   - kochia (6.7)
   - lamb's-quarters (8.8)
   - mustard, wild (8.8)
   - pigweed, redroot (8.8)
   - rapeseed, volunteer (8.8)
   - smartweed, annual (8.6)
   - shepherd's-purse, rosette (9.0)
   - stinkweed, rosette (8.7)
5. WEEDS SUPPRESSED: None
6. WHEN APPLIED: Apply at the 3-4 leaf stage of green foxtail (under 2.5 cm in height). Under dry conditions (soil moisture is deeper than 5 cm) apply when green foxtail is at the 2-3 leaf stage. Apply at 3-4 leaf of broadleaf weeds and 1-4 leaf of smartweed. Cereal crops must be at the 2-5 leaf stage and flax must be between 5 and 12 cm in height. Do not spray flax when temperatures exceed 30°C.
7. HOW TO APPLY:
   With: Ground Equipment only. Spra-coupe not recommended.
   Rate: 1.1 L/ac
   Water Volume: Field sprayers - 40 L/ac. Floater type equipment - 60 L/ac
   Pressure: 275 kPa
   Ground Speed: 8 km/h field sprayers, 20 km/h or less for floaters.
   Nozzles: Only flat fan nozzles. Flooding nozzles can be used on floaters.
8. SPRAYING TIPS:
   (a) ***Mixing Procedures:*** Fill spray tank with 1/2 the required amount of water. Add Stampede CM, engage agitator and add remainder of water. Water used should be 10°C or warmer. Spray Stampede CM within 6 hours of mixing.
   (b) A 3 day interval is required before or after an application of Stampede CM and another herbicide. If an insecticide treatment is required, use Furadan, and wait a minimum of 5 days after Stampede CM application in wheat and 10 days in barley. For Dimethoate (Cygon) or Malathion allow a minimum interval of 14 days. Decis may be applied anytime before or after a Stampede CM application. Do not apply Stampede CM in fields to which Atrazine has been applied during the previous 2 years. Crops grown from seed treated with dual purpose (fungicide/insecticide) seed dressings may be treated with Stampede CM.
   (c) Long term crop injury may occur if applied to crop under severe stress or if frost is expected within 24 hours.
   (d) Under hot, dry and low relative humidity conditions spray during early morning or evening.
   (e) Apply Stampede CM when temperatures are expected to exceed 10°C.
   (f) Apply to cereals no later than the 5 leaf stage.
9. HOW IT WORKS: Rapidly absorbed by foliage to cause breakdown of cell walls and cellular metabolism. The MCPA component causes phenoxy-specific symptoms. Activity is essentially contact, and thorough spray coverage is necessary for optimum weed control. Weeds become tolerant beyond the 4 leaf stage as well as under stress conditions.
10. EXPECTED RESULTS: ***Weeds:*** Within 3-5 days, weeds turn brown and have a "burnt off" or dried out appearance. Weeds past the recommended stage will show extensive desiccation, but some green tissue remains and new growth may be generated enough to recover. Weeds emerging after spraying are unaffected. ***Crops:*** Temporary yellowing, and leaf tip burn will usually be more noticeable in barley, oats and flax than wheat. These effects disappear 10-14 days after treatment. New growth develops normally and yields are not reduced. Applied under extreme stress conditions, Stampede CM may cause a slight delay in crop maturity, and some suppression of growth in flax. This may be offset by increased yield due to weed control.
11. EFFECTS OF RAINFALL: Rainfall 1 hour after treatment will not affect performance.
12. MOVEMENT IN SOIL: Not applicable
13. GRAZING AND CROPPING RESTRICTIONS: None. ***Drift:*** Danger is low; MCPA has a low volatility.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,950). Propanil has potential to cause chlorachne - a skin disease in man following prolonged exposure.
15. PRECAUTIONS, FIRST AID: Symptoms of poisoning may be giddiness, intoxication and headache. Wear standard protective clothing (see page 2) to reduce skin exposure since propanil can cause skin problems. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: Heated storage is not required. If frozen, warm and agitate thoroughly to redissolve crystals.

STAMPEDE 360 (propanil)

Rohm and Haas

WARNING POISON

1. FORMULATIONS: Emulsifiable concentrate; 360 g/L; 11.4 L.

2. REGISTERED MIXES: Stampede 360+MCPA ester - spring and durum wheat, barley, oats, flax. Stampede 360 - 2,4-D L.V. ester or amine - spring and durum wheat. Stampede 360+Glean - spring and durum wheat, barley (Argyle, Bedford and Klages only).

3. CROPS: Spring wheat (8.8), durum wheat (8.7), barley (8.4), oats (8.9), flax (8.4).

4. WEEDS CONTROLLED:

Stampede 360 (alone)
buckwheat, Tartary (7.6)
wild (8.0)
foxtail (green, yellow)(7.3)
lamb's-quarters (8.3)
pigweed, redroot (8.7)
shepherd's-purse (9.0)
smartweeds, annual (8.0)
stinkweed (8.1)

360+MCPA (ester)
360 weeds +
bluebur(7.8)
flixweed (7.4)
kochia (6.7)
lady's thumb
rapeseed, volunteer (8.8)

360+2,4-D (amine or ester)
360 weeds+ burdock
clover, sweet
cocklebur
goat's-beard
hawk's-beard, narrow-leaved
lettuce, prickly
pigweed, Russian
plantain
radish, wild
sunflower, annual
thistle, Russian (7.5)

360+Glean
360 weeds +
chickweed
cow cockle (9.0)
flixweed
hempnettle (8.3)
kochia (4.8)
lady's-thumb
mustard, wild (8.0)
rapeseed, volunteer (8.1)
thistle (Canada (6.6), Russian (6.2))

5. WEEDS SUPPRESSED: None

6. WHEN USED: ***Weeds:*** Green foxtail 3-4 leaf stage and less than 2.5 cm in height. Under dry conditions apply at the 2-3 leaf stage. ***Broadleaf weeds:*** 2-4 leaf stage, 1-4 leaf of smartweed. ***Crops:*** Apply to cereals in the 2-5 leaf stage, with 2,4-D apply to wheat in 3-5 leaf stage. Flax 5-10 cm in height. Application should be made within 17 days of crop emergence (21 days after seeding).

7. HOW TO APPLY:
With: Ground equipment only. Spra-coupe not recommended.
Rate: 1.1 L/ac. When tank mixing, add 220 mL/ac MCPA ester 500 for wheat (spring, durum), barley, oats, flax; 320-480 mL/ac 2,4-D ester 500 or 480 mL/ac 2,4-D amine 500 for spring wheat; 320 mL/ac ester 500 or 480 mL/ac 2,4-D amine 500 for durum wheat; 6-12 g/ac of Glean for wheat (spring, durum) and barley (Argyle, Bedford, Klages).
Water Volume: Field sprayers - 40 L/ac. Floater type equipment - 60 L/ac
Pressure: 275 kPa
Ground Speed: 8 km/h for field sprayers, 20 km/h or less for floaters
Nozzles: Only flat fan nozzles. Flooding nozzles can be used on floaters.

8. SPRAYING TIPS:
(a) ***Mixing Procedures:*** Fill tank with 1/2 required amount of water, add MCPA, 2,4-D or Glean, then add Stampede 360. Agitate and continue filling with water to the required volume. Agitate at least 5 minutes immediately before spraying. Water should be 10°C or warmer. Spray the solution within 8 hours of mixing. Drain and flush sprayer tank and lines after spraying is completed.
(b) A 3 day interval should be allowed before or after an application of Stampede 360 and another herbicide. If an insecticide treatment is required, use Furadan, waiting a minimum of 5 days after Stampede 360 application in wheat and 10 days in barley. Dimethoate (Cygon TM) or Malathion may also be used, but allow a minimum interval of 14 days following a Stampede 360 application. Decis may be applied anytime before or after a Stampede 360 application. Crops grown from seed treated with dual purpose (fungicide/insecticide) seed dressings may be treated with Stampede 360. Do not apply Stampede 360 in fields to which Atrazine has been applied during the previous 2 years.
(c) Long term crop injury may occur if applied to crop under severe stress or if frost is expected within 24 hours.
(d) Under hot, dry and low relative humidity conditions, spray during early morning or evening.
(e) Apply Stampede 360 when temperatures are expected to exceed 10°C.
(f) Apply to cereals no later than the 5 leaf stage.

9. HOW IT WORKS: Stampede 360 is absorbed by leaves and causes cell wall breakdown and interference with the cellular metabolism. Activity is primarily contact, therefore, thorough spray coverage is necessary for optimum weed control. Susceptible weeds become tolerant beyond the 4 leaf stage. Stress conditions will trigger a hardening off process and hasten the development of tolerance to chemical control.

10. EXPECTED RESULTS: ***Green foxtail, broad-leaf weeds:*** Affected weeds turn brown in 3-5 days and have a "burnt-off", or desiccated, appearance. Weeds past the recommended stage will show extensive browning, but some degree of green, tissue remains. New tissue is produced, and the weed will recover. Weeds emerging after spraying are unaffected. ***Crops:*** Temporary yellowing and leaf tip burn occur and is more pronounced in oats, flax and barley than in wheat. Effects will disappear 10-14 days after treatment. New growth is not affected and yields are not reduced. Under stress conditions, a slight delay in crop maturity may be noticed.

11. EFFECTS OF RAINFALL: Light rainfall 1 hour after application will not affect performance.

12. MOVEMENT IN SOIL: Not applicable

13. GRAZING AND CROPPING RESTRICTIONS: None.

14. TOXICITY: Slightly high acute mammalian toxicity; oral LD_{50} rats (mg/kg) = technical (560). Propanil has potential to cause chlorachne - a skin disease in man following long-term exposure.

15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to reduce skin exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Symptoms of poisoning may be giddiness, intoxication and headache. IF SWALLOWED - do NOT induce vomiting. Get medical attention.

16. STORAGE: Heated storage not required. If frozen, warm and agitate thoroughly to redissolve crystals.

SWEEP (paraquat)

Chipman

1. FORMULATIONS: Water soluble solution 250 g/L; 20 L container.
2. REGISTERED MIXES: With bromoxynil + MCPA; dicamba + 2,4-D; Lorox + MCPA; 2,4-D; MCPA.
   Mix Restrictions: With amine formulations use immediately. Mixing with other pesticides: Not applicable.
3. CROPS: Summerfallow Underseeding: Not applicable
4. WEEDS CONTROLLED: Annual grasses and annual broad-leaf weeds when tank-mixed with broad-leaf herbicide.
5. WEEDS SUPPRESSED: Most perennial weeds
6. WHEN USED: At the 2-4 leaf stage of annual weeds.
7. HOW TO APPLY:
   With: Ground equipment
   Rate: 910 mL/ac for annual grass control.
   Water Volume: 45 L/ac. Use higher volumes when foliage is dense or weeds are in the 4 leaf stage.
   Pressure: 300 kPa
8. SPRAYING TIPS:
   (a) Apply Sweep + Lorox + MCPA mix only once per year in spring.
   (b) Use very clean water as muddy water will inactivate chemical.
   (c) Applications made on cloudy days, during dull sunlight or periods of darkness will generally increase the effectiveness.
   (d) Do not apply with mist blowers.
   (e) Thoroughly wash equipment after spraying.
9. HOW IT WORKS: A contact herbicide absorbed by leaves and stems. Interferes with photosynthesis and causes yellowing and eventual death.
10. EXPECTED RESULTS: ***Weeds:*** Sweep provides immediate, fast and virtually complete annual grass control. Repeat applications will be necessary when new weeds emerge. Yellowing occurs in a few hours, followed by rapid desiccation and later death. When tank-mixed with a broad-leaf herbicide, most annual weeds will be controlled. Thorough coverage of weeds is essential. ***Crop:*** Not applicable.
11. EFFECTS OF RAINFALL: No effect once the spray solution has dried on the plant tissue.
12. MOVEMENT IN SOIL: None.
13. GRAZING AND CROPPING RESTRICTIONS: None.
14. TOXICITY: **Very high** acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (120). **May be fatal if swallowed.**
15. PRECAUTIONS; FIRST AID: KEEP OUT OF REACH OF CHILDREN AND ANIMALS. Wear standard protective clothing (see page 2) plus a pesticide respirator to avoid skin and lung exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). . IF SWALLOWED - induce vomiting (see page 3). See a doctor immediately.
16. STORAGE: Never transfer to other containers. Store tightly in original containers and in a safe place. Heated storage.

TARGET (MCPA + mecoprop + dicamba)

Ciba-Geigy

CAUTION POISON

1. FORMULATIONS: Water soluble solution containing 275 g/L MCPA + 62.5 g/L mecoprop + 62.5 g/L dicamba; 2 X 10 L jugs.
2. REGISTERED MIXES: Target + Sencor 500 F, Target + Lorox L or Afolan F, 28-0-0 Liquid nitrogen (winter wheat only).
3. CROPS: Hard red spring and durum wheat (8.4), winter wheat (8.5), barley (8.5), oats (9.0), annual canary grass (8.5). Thistle control on fallow.
4. WEEDS CONTROLLED:

buckwheat	hemp-nettle (7.0)	night-flowering catchfly (7.5)	sow-thistle, annual
(Tartary, wild)(8.0)	knotweed	pigweed (prostrate, redroot)(8.8)	stinkweed (8.4)
cleavers (7.5)	kochia (8.0)	rapeseed, volunteer (8.5)	sunflowers, volunteer (8.0)
corn spurry (8.8)	lamb's-quarters (8.7)	shepherd's-purse	thistle, Russian (8.5)
cow cockle (8.5)	mustards (8.8)	smartweeds, annual (8.3)	
flixweed			

5. WEEDS SUPPRESSED: Canada thistle, bindweed (field and hedge).
6. WHEN USED: Wheat, oats - 2-5 leaf stage, Barley - 2-3 leaf stage, winter wheat - apply in spring before crop is more than 30 cm tall. Summerfallow - thistles are in the early bud stage. Weed growth stage - 2-5 leaf stage. **NOTE:** Treatment at other than recommended crop stage may cause injury.
7. HOW TO APPLY:
   With: Ground equipment.
   Rate: 405-610 mL/ac. 610-810 mL/ac on summerfallow for thistle control.
   Water Volume: 40 L/ac
   Pressure: 275 kPa
8. SPRAYING TIPS:
   (a) For hemp-nettle control, apply before the second pair of leaves appear.
   (b) Use the higher rate when weeds are beyond the 3 leaf stage, when weed densities are high or under adverse weather conditions.
   (c) Use 610 mL/ac rate when cleavers are in the 1-2 whorl stage.
   (d) In winter wheat, spray winter annuals as soon as growth begins or if 28-0-0 liquid nitrogen is used as the carrier.
   (e) When using 28-0-0 liquid nitrogen as carrier, use 45 L/ac of total solution. Do not let contents stand for long periods of time without agitation.
9. HOW IT WORKS: Target is a combination of 3 systemic hormonal herbicides which accummulate in the growing point of susceptible plants, produce abnormal growth and disrupt the transport system in plants.
10. EXPECTED RESULTS: ***Weeds:*** Visible effects occur 7-14 days after treatment. Leaves curl, leaf edges turn brown, petioles twist, plant ceases growth and turns brown and dies. ***Crop:*** Improper or untimely application can result in abnormal bending at the nodes of grain stalks, difficulty in head emergence from sheath, curled awns, malformed kernels and sterile florets. ***Poor results may be expected if:*** there is poor coverage, rainfall less than 3 hours after application or weeds too advanced. Dicamba containing products can be hard on crops if incorrectly applied.
11. EFFECTS OF RAINFALL: Rainfall within 3 hours will reduce activity.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: None. ***Drift:*** Most vegetables and fruit crops are very sensitive.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,028). **Long-term continuous exposure to this product may produce enlarged kidneys.** Non-toxic to fish; toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to avoid exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Heated storage only.

TORCH DS (bromoxynil)
Union Carbide

1. FORMULATIONS: Emulsifiable Concentrate; Torch DS - 450 g/L, 10 L.

2. REGISTERED MIXES:
   With: Avenge alone or with MCPA ester; 2,4-D (amine or ester); MCPA (amine or ester); MCPA-K; Roundup; Atrazine; Hoe-grass 284.
   Mixing restrictions: Add amine 2,4-D; MCPA or MCPA-K to water first and then add bromoxynil.

3. CROPS:

barley (9.0)	triticale (8.9)	*Seedling grasses grown for seed*	reed canary grass
canary grass (9.0)	wheat, durum (8.9)	bromegrass	Russian wild rye (9.0)
corn, field (9.0)	wheat, spring (8.9)	fescue, meadow (8.3)	timothy
corn, sweet (7.9)	wheat, winter	orchard grass (8.9)	wheatgrass (crested, intermediate, slender, tall)(8.5)
flax (8.6)	zero till		

4. WEEDS CONTROLLED:

buckwheat (Tartary, wild)(8.4)	groundsel, common (9.0)	mustard, wild (8.5)
catchfly, night-flowering (7.6)	knawel (7.7)	pigweed, redroot (7.9)
cow cockle (7.9)	kochia (8.2)	smartweeds, annual (8.1)
	lamb's-quarters (8.4)	stinkweed (8.4)
		thistle, Russian (8.4)

5. WEEDS SUPPRESSED: None

6. WHEN USED: ***Weeds:*** Seedling to 4 leaf stage except Russian thistle to 5 cm tall. Generally best results if weeds are in seedling stage. ***Crops:*** Wheat, barley, oats, triticale - 2 leaf to early flag leaf. Use tank mix with 2,4-D on wheat or barley after 4 leaf. Winter wheat, fall rye - first growth to early flag leaf. Winter wheat - fall - 2 - 4 leaf. Corn - used alone or with atrazine - until crop is 25 cm tall, then use alone with drop pipes. Flax when 5-10 cm tall. Canary seed grass - 3-5 leaf. Seedling grasses, grown for seed - 2-4 leaf.

7. HOW TO APPLY: Ground equipment. Spra-coupes - not recommended.

Rate: Crop	Torch DS
Wheat, barley, oats, corn (field, sweet), canary seed, triticale	250-300 mL/ac
Flax	250 mL/ac
Winter wheat	300 mL/ac
fall rye, seedling grasses (grown for seed)	350 mL/ac

   Water volume: 40 L/ac. Corn - 60 L/ac.
   Pressure: 275 kPa
   Nozzles: Flooding type nozzles not recommended.

8. SPRAYING TIPS: To control scentless chamomile and knawel, spray before 3 leaf stage.

9. HOW IT WORKS: Bromoxynil is a contact herbicide so good coverage is essential. Inhibits respiration and photosynthesis causing death.

10. EXPECTED RESULTS: ***Weeds:*** turn brown and die within 3-5 days - more rapid under good growing conditions and when applied to seedling weeds. ***Poor results can be expected if:*** weeds past 4 leaf stage, poor spray coverage or, lower than recommended rate used. Injury to corn or flax may occur if under stress.

11. EFFECTS OF RAINFALL: None.

12. MOVEMENT IN SOIL: None.

13. GRAZING AND CROPPING RESTRICTIONS: None.

14. TOXICITY: High acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (245). Symptoms of acute poisoning such as stomach cramps, diarrhea, sore throat may appear. Very toxic to fish, snails and slugs.

15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) when applying. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - Do NOT induce vomiting. Get medical attention.

16. STORAGE: Does not require heated storage.

TORDON (Industrial) (picloram)

Dow

Available only to approved personnel.

1. FORMULATIONS: Tordon 10K pellets - 10% picloram - 25 kg. Tordon 22K herbicide - 240 g/L as potassium salt - 18.9 L. Tordon 101 Mixture - picloram - 60 g/L + 2,4-D - 240 g/L, 18.9 L, 205 L.
2. REGISTERED MIXES: None.
3. CROPS: Tordon 10K pellets are registered for brush control. Tordon 101 Mixture for brush control and weeds on rights-of-way. Tordon 22K for controlling deep rooted perennial and biennial weeds on rangeland, permanent grass pastures, non-cropland and for spot treatment on crop land, when applied by an authorized pesticide applicator.
4. WEEDS: Tordon will control most broad-leaved weeds and brush.
5. WEEDS SUPPRESSED: None.
6. WHEN USED: Tordon 101 Mixture and Tordon 22K - applied after leaves are fully expanded until about 3 weeks before frost. Tordon 10K pellets - applied in spring, just before or during periods of vigorous growth.
7. HOW TO APPLY:

	Tordon 10K Pellets	Tordon 22 K	Tordon 101 Mixture
With:	Cyclone spreader, ground operated granular spreader, aerial spreader	Boom or hand gun	Ground equipment or helicopter using drift control agent.
Rate:	16-30 kg/ac depending upon species	450 mL-3.6 L/ac depending upon weed species	Brush - 10 L in 1000 L water and spray to point of runoff. Weeds - 2.8 L/ac

Water Volume: Use 80-800 L/ac of water, depending upon density of growth.

8. SPRAYING TIPS: Spread Tordon 10K Pellets evenly over the ground surface above tree roots. Higher rates may cause grass injury in drier areas of the province.
   Tordon 22K used as a spot treatment in a crop. No spot treatment should exceed 1 acre, and the total area treated in any 1 field in a year should not exceed 5% of the total acreage.
   NOTE: Picloram is extremely persistent and water soluble, and small quantities may cause damage to desirable plants. Do not apply, or permit any Tordon herbicide to contaminate soil used to grow desirable susceptible plants. Do not contaminate water used for irrigation or domestic purposes.
9. HOW IT WORKS: Interferes with cell division, causing leaf cupping, stem distortion and eventual death of plant. Tordon 10K pellets require moisture to carry picloram to the roots. Tordon 101 and 22K are absorbed through leaves and roots.
10. EXPECTED RESULTS: ***Tordon 10K Pellets:*** 2-3 weeks after the first rainfall after treatment, leaves of affected trees become dull and cupped; orange streaks appear on the stems of poplar trees, leaves become brown and brittle, as the tree dies. ***Tordon 101 Mixture:*** 2-3 weeks after treatment symptoms as above occur. ***Tordon 22K Herbicide:*** Perennial weeds show distorted stems and cupped leaves, which turn yellow and then brown. Usually native grass increases in abundance as a result of reduced competition. ***Poor results may be expected if:*** there is heavy rainfall immediately after treatment on light sandy soil.
11. EFFECTS OF RAINFALL: Heavy rainfall may dissolve and carry picloram away from the target area, or percolate dissolved picloram out of the root zone of target plants.
12. MOVEMENT IN SOIL: Picloram is very soluble in water and moves readily with water.
13. GRAZING AND CROPPING RESTRICTIONS: Manure from picloram treated vegetation should not be used to grow sensitive crops but rather be returned to a cereal crop field. When applied as a spot treatment on cropland, picloram may persist in soil for up to 5 years, and prevent the establishment of sensitive crops. Where wheat, oats, barley and canola are the major crops in the rotation program, the following sequence is suggested to start the year after treatment: **First Year:** Oats or canola. **Second Year:** Oats, canola or barley. **Third Year:** Oats, canola, barley or wheat. A reduction in yield in the first year, is usually offset by benefits of weed control obtained. Legumes may not be established in a pasture for several years after a Tordon herbicide treatment. If legumes are essential in a pasture, do not use Tordon herbicide.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = Technical Picloram (8,200); Tordon 10K Pellets (5,000); Tordon 101 Mixture (3,080); Tordon 22K (10,330).
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Tordon 10K Pellets: Store in a cool, dry place. Tordon 22K Herbicide and Tordon 101 Mixture: Store in a cool, dry place. Do not freeze. If freezing occurs, bring to room temperature and mix thoroughly.

TORDON 202C (picloram + 2,4-D)

Dow

1. FORMULATIONS: Picloram 12 g/L + 2,4-D 200 g/L, 20 L
2. REGISTERED MIXES: None
3. CROPS: Barley (8.7) and wheat (7.7). Underseeding: Not recommended.
4. WEEDS CONTROLLED:

buckwheat, Tartary (4.7)	cocklebur	mustard, wild (8.6)	smartweed, green (5.9)
buckwheat, wild (7.2)	dandelion	pigweed, redroot (7.1)	stinkweed (seedlings)

5. WEEDS SUPPRESSED: Scentless chamomile, Canada thistle.
6. WHEN USED: 3-5 leaf stage of crop. Seedling (2-4 leaf) stage of weeds.
7. HOW TO APPLY:
   With: Ground equipment
   Rate: 600-800 mL/ac
   Water Volume: 40 L/ac
   Pressure: 275 kPa
8. SPRAYING TIPS: Treat during warm weather when the weeds are young and growing actively. Use the maximum rates under dry or cool conditions.
9. HOW IT WORKS: Absorbed by leaf, stem and roots and translocated throughout the plant to the growing points. Some soil residue controls late germinating weeds.
10. EXPECTED RESULTS: Death of weeds is not immediate but growth is slowed and eventually ceases. Under dry conditions straw shortening in wheat may occur, but yield may not be affected.
11. EFFECTS OF RAINFALL: Rainfall within 4-6 hours of application may reduce activity.
12. MOVEMENT IN SOIL: Picloram degrades very slowly in soil and water, and may be leached out, after rainfall, from soils low in organic matter.
13. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Small amounts can damage many desirable broad-leaf plants. ***Use of Straw from Treated Fields:*** Do not use straw from treated crops for compost or mulching on susceptible broad-leaf crops. If straw is used for bedding or animal feed return the manure to fields to be planted to grain crops, flax or rapeseed. ***Rotational crops:*** Fields previously treated with Tordon 202C may be seeded to rapeseed (including canola), mustard, flax, wheat, oats, barley or summerfallow. ***Succeeding crops:*** Certain desirable broadleaf crops can be damaged by small amounts of Tordon 202C in the soil. Alfalfa and sunflower should be planted at least 3 years after treatment. Beans, lentils, peas and potatoes after 5 years. ***Handling Treated Soils:*** Treated soil should not be moved to other areas, nor used to grow susceptible broad-leaf plants unless an adequately sensitive bioassay or chemical test shows that no detectable picloram is present.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (2,460). May cause eye irritation. Non-toxic to fish and bees. There is no dioxin in the 2,4-D of this formulation.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to avoid exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Heated storage. If freezing occurs, warm and mix thoroughly before using.

TREFLAN (trifluralin)

Elanco

(Cereals)

1. FORMULATIONS: Treflan: Emulsifiable concentrate 545 g/L, 8.5 L container.
2. REGISTERED MIXES: With Avadex BW, Liquid Fertilizer, and Avadex BW + Liquid Fertilizer.
   Mix Restrictions: Add Treflan or Treflan + Avadex directly into the liquid fertilizer, mix thoroughly and apply as soon as possible. Agitate until application is complete.
3. CROPS: Wheat (spring and durum), barley.
   Underseeding: Not recommended.
4. WEEDS CONTROLLED: Green foxtail.
5. WEEDS SUPPRESSED: None
6. WHEN USED: Apply alone or as a tank mix with Avadex BW in the spring after seeding and prior to emergence of wheat or barley.
7. HOW TO APPLY:
   With: Ground Equipment
   Rate: 445 mL/ac on light to medium textured soil. 610 mL/ac on heavy textured soil.
   Water Volume: 40 L/ac
   Incorporation: Incorporate 2-4 cm with two cross harrowings with tyne or diamond harrows operated at a speed of at least 9 km/h. Both incorporations should be done within 24 hours of application.
   Pressure: 275 kPa
8. SPRAYING TIPS: Apply only on fields that are trash free or summerfallow fields. Crop must be seeded 5-8 cm deep in a well tilled seedbed to prevent contact between the chemical and the seed.
9. HOW IT WORKS: Acts on both the root and shoot tips as they emerge. Prevents cell division and affected plants die before emergence. If the shoot portion of the plant escapes to the soil surface, lateral or secondary root growth is inhibited causing a slow death since the plant is unable to gather moisture or nutrients.
10. EXPECTED RESULTS: ***Green Foxtail:*** Seeds germinating in the treated layer die before reaching the soil surface because root and shoot growth are inhibited. Seeds germinating below the treated layer will produce plants that will emerge. The secondary root system of plants that form within the treated layer is completely inhibited by trifluralin present in that area. The affected plant dies slowly as crop competition and temperature stress over-tax the rootless plant's ability to take up moisture. ***Crop:*** injury is minimized when seeded to a depth of 5-8 cm.
11. EFFECTS OF RAINFALL: No effect once incorporated into the soil.
12. MOVEMENT IN SOIL: None.
13. GRAZING AND CROPPING RESTRICTIONS: None.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (10,000). In clean water, fish are very sensitive to trifluralin; but in runoff and muddy water, trifluralin binds to the suspended soil particles and large amounts can be tolerated by fish. Non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: Do not store below 5°C. If stored below 5°C, bring the contents to 15°C for 24 hours and shake well before using.
    SPECIAL USE: Treflan QR5 on Barley ONLY.
    (a) Weeds Controlled/Spraying Tips: See QR5 under Treflan (oilseed).
    (b) When Used: Fall application only. September 1 to freeze up.
    (c) How to Apply: See QR5 under Treflan (oilseed).
    (d) Rate: On sandy textured brown and dark brown soil (2-4% O.M.): 6.9 kg/ac. On medium or heavy textured brown and dark brown soils (2-4% O.M.): 8.9 kg/ac. On light black soils (4-6% O.M.): 8.9 kg/ac. On medium or heavy textured black soils (4-6% O.M.): 11.3 kg/ac.
    (e) Warning: Do not apply on soils containing less than 2% organic matter or on deep black soil containing more than 6% organic matter. Application to severely eroded knolls may result in reduced crop stand. Do not apply on land treated with Treflan since June 1 of the previous year. Using press or hoe drill, seed 5 cm deep into a moist, warm seedbed. Avoid seeding into very cold soil.

TREFLAN (trifluralin)

Elanco

(Oilseeds, Special Crops)

1. FORMULATIONS: Treflan: Emulsifiable concentrate 545 g/L (Treflan 545EC), 8.5 L. 5% Granular (Treflan QR5), 25 kg bags.
2. REGISTERED MIXES: Treflan + Liquid Nitrogen Fertilizer (28-0-0). (Pour directly into liquid fertilizer, mix thoroughly and apply as soon as possible with constant agitation.)
   Treflan 545 EC + Sencor 500 F or 75 DF - Fababeans, Triazine tolerant canola (see Spectrum).
3. CROPS:

canola, triazine tolerant	beans, lima	lentils* (8.7)	rapeseed (8.8)
crambe	fababeans (8.6)	mustard (9.0)	soybeans (8.8)
beans, dry (8.0)	flax*(7.7)	peas (8.7)	sunflowers (9.0)

   * Fall application only.
   Underseeding: Not recommended.
4. WEEDS CONTROLLED:

annual bluegrass	chickweed (7.1)	knotweed	purslane
barnyard grass (8.3)	cow cockle (9.0)	lamb's-quarters (8.0)	thistle, Russian (7.9)
bromegrass	downy brome	Persian darnel	wild oats (7.5)
buckwheat, wild (8.3)	foxtail (green, yellow)(8.1)	pigweed (8.2)	

5. WEEDS SUPPRESSED: None.
6. WHEN USED: ***Spring application:*** cultivate to destroy existing weeds and apply pre-plant. ***Fall application:*** September 1st to freeze-up. **Fall incorporation is discouraged where soil drifting is a problem.** ***Summer application:*** On summerfallow between June 1st to September 1st. ***Special Instructions for Flax, Lentils:*** Not recommended for spring application. Both incorporations of Treflan or QR5 must be done in the fall. Shallowly till and pack the soil in the spring to ensure a firm seedbed and an accurate depth for seeding.
7. HOW TO APPLY:
   With: Ground equipment only.
   Rate:
   Spring Application - (a) Treflan 610 mL/ac on sandy soils with less than 6% organic matter. (b) Treflan 810 mL/ac on all medium and heavy textured soils up to 15% organic matter and on sandy soils with greater than 6 but less than 15% organic matter. (c) Treflan 1050 mL/ac on medium and heavy textured soils with 6-15% organic matter and high wild oat pressure.
   Fall Application - (a) 810 mL/ac 545 EC, QR5: 8.9 kg/ac on sandy soils less than 6% organic matter. (b) 1050 mL/ac 545 EC, QR5 11.3 kg/ac on all medium or heavy textured soils up to 15% organic matter and for sandy soild with greater than 6% but less than 15% organic matter. (c) 1.2 L/ac 545 EC, QR5 13.7 kg/ac on medium and heavy textured soils with 6-15% organic matter and high wild oat pressure.
   Summer Application - Between June 1st and September 1st. Treflan - 1.2 L/ac. Treflan QR5 - 13.7 kg/ac.
   Triazine Tolerant Canola - See Spectrum or Sencor for application rates as a tank mix with Sencor. Treflan 545 EC and QR5 alone may be applied in the summer, fall and spring for Triazine Tolerant Canola. Sencor or Bladex may then be applied after crop emergence to control several additional weeds.
   Water Volume: 40 L/ac
   Incorporation: First incorporation at a right angle must be done within 24 hours of application. A tandem disc, discer or field (vibra shank) cultivator are recommended for incorporating to 8-10 cm. To get the best mixing action, operate the disc implement at 6-10 km/h and the cultivator at 10-13 km/h.
   Pressure: 275 kPa
8. SPRAYING TIPS:
   (a) Do not apply Treflan 545EC to soils with more than 20-25% straw cover or on standing weeds. On stubble, chop and thoroughly mix residues into the soil prior to addition of Treflan EC.
   (b) Treflan QR5 can be used when trash is heavier provided it does not interfere with the distribution of the granule and does not limit incorporation
   (c) Delay second incorporation of QR5 for 3 days. This allows time for greater release of QR5 into the soil and assures a more uniform distribution.
   (d) A tandem disc gives the best mixing action on stubble conditions
   (e) Do not use a field cultivator to incorporate Treflan when soil is crusted, lumpy or too wet for good mixing.
   (f) Fall application should be followed with 2 incorporations at right angles, before freeze-up.
   (g) Fall or summer application should be followed by a light spring tillage to a 5-8 cm deep before seeding.
   (h) Do not apply on soils that are wet, in poor tilth, or contain 15% or more organic matter.
   (i) To avoid concentrating wild oat seeds below the treated layer, do not plow land prior to Treflan application.
   (j) Overapplication caused by overlapping or improper calibration or non-uniform application may reduce the stand of crop grown in rotation.
9. HOW IT WORKS: Treflan kills seedlings as they germinate. Inhibits cell division in the actively growing points of the root and shoot.
10. EXPECTED RESULTS: ***Weeds:*** Most weeds die before emerging. Weeds will exhibit swelling in the coleoptile region,

stubby, thick primary root development and lack of secondary roots, which leads to death due to inadequate moisture obtaining ability. *Crop:* seed flax into a well packed warm moist seedbed. Do not seed deeper than 4 cm.

11. EFFECTS OF RAINFALL: No effect once Treflan is incorporated into the soil.
12. MOVEMENT IN SOIL: None.
13. GRAZING AND CROPPING RESTRICTIONS: None. *Crop Use After Hail:* No restrictions *Succeeding Crops:* Normally, Treflan carry over will not harm crops grown in rotation. As a precaution, oats, sugar beets and small seeded annual grasses should not be grown in rotation following a trifluralin treated crop. Drought conditions in the year of treatment may result in higher levels of trifluralin carry-over into the next year. To avoid wheat injury, seed less than 7 cm deep into a warm moist seedbed.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (10,000). In clean water, fish are very sensitive to trifluralin, but in run off or muddy water, it binds to soil particles and large amounts can be tolerated by fish. Non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: Do not store below 5°C. If stored below 5°C, bring the contents to 15°C for 24 hours and shake well before using. Do not store near heat, spark or open flame.

Triflurex (trifluralin)

Makhteshim – Agan

(Cereals)

1. FORMULATIONS: Triflurex: Emulsifiable concentrate 400 g/L, 22.7 L
2. REGISTERED MIXES: With Avadex BW, Liquid Fertilizer, and Avadex BW + Liquid Fertilizer.
   Mix Restrictions: Add Triflurex or Triflurex + Avadex directly into the liquid fertilizer, mix thoroughly and apply as soon as possible. Agitate until application is complete.
3. CROPS: Wheat (spring and durum), barley.
   Underseeding: Not recommended.
4. WEEDS CONTROLLED: Green foxtail.
5. WEEDS SUPPRESSED: None
6. WHEN USED: Apply alone or as a tank mix with Avadex BW in the spring after seeding and prior to emergence of wheat or barley.
7. HOW TO APPLY:
   With: Ground Equipment
   Rate: Triflurex at 565 mL/ac on light to medium textured soil. Triflurex at 850 mL/ac on heavy textured soil.
   Water Volume: 40 L/ac
   Incorporation: Incorporate 2-4 cm with 2 cross harrowings with tyne or diamond harrows operated at a speed of at least 9 km/h. Both incorporations should be done within 24 hours of application.
   Pressure: 275 kPa
8. SPRAYING TIPS: Apply only on fields that are trash free or summerfallow fields. Crop must be seeded 5-8 cm deep in a well tilled seedbed to prevent contact between the chemical and the seed.
9. HOW IT WORKS: Acts on both the root and shoot tips as they emerge. Prevents cell division and affected plants die before emergence. If the shoot portion of the plant escapes to the soil surface, lateral or secondary root growth is inhibited causing a slow death since the plant is unable to gather moisture or nutrients.
10. EXPECTED RESULTS: ***Green Foxtail:*** Seeds that germinate below the treated layer will produce plants that will emerge. The secondary root system of plants that form within the treated layer is completely inhibited by trifluralin present in that area. The affected plant dies slowly as crop competition and temperature stress over-tax the rootless plant's ability to take up moisture. ***Crop:*** injury is minimized when seeded to a depth of 5-8 cm.
11. EFFECTS OF RAINFALL: No effect once incorporated into the soil.
12. MOVEMENT IN SOIL: None.
13. GRAZING AND CROPPING RESTRICTIONS: None.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (10,000). In clean water, fish are very sensitive to trifluralin; but in runoff and muddy water, trifluralin binds to the suspended soil particles and large amounts can be tolerated by fish. Non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: Do not store below 5°C. If stored below 5°C, bring the contents to 15°C for 24 hours and shake well before using. Do not store near heat, spark or open flame.

Triflurex (trifluralin)
Makhteshim – Agan

(Oilseeds, Special Crops, Vegetable Crops)

1. FORMULATIONS: Triflurex: Emulsifiable concentrate 400 g/L, 22.7 L
2. REGISTERED MIXES: Triflurex + Liquid Nitrogen Fertilizer (28-0-0). (Pour directly into liquid fertilizer, mix thoroughly and apply as soon as possible with constant agitation.)
3. CROPS:

beans, dry (8.0)	cabbage	fababeans (8.6)	peppers
beans, lima, snap (8.8)	carrots (8.4)	flax (7.7)	rapeseed (8.8)
beans, soy (8.9)	canola, triazine tolerant	lentils* (8.7)	sunflowers (9.0)
broccoli, transplants (9.0)	cauliflower	mustard (9.0)	tomatoes, transplants (9.0)
brussel sprouts, transplants (9.0)	crambe	peas (8.7)	turnips

* Fall application only.

Underseeding: Not recommended.

4. WEEDS CONTROLLED:

barnyard grass (8.3)	buckwheat, wild (8.3)	foxtail (green, yellow) (8.1)	pigweed (8.2)
bluegrass, annual	chickweed (7.1)	knotweed	purslane
bromegrass	cow cockle (9.0)	lamb's-quarters (8.0)	thistle, Russian (7.9)
brome, downy	darnel, Persian	oats, wild (7.5)	

5. WEEDS SUPPRESSED: None.
6. WHEN USED: ***Spring application:*** cultivate to destroy existing weeds and apply pre-plant. ***Fall application:*** September 1st to freeze-up. **Fall incorporation is discouraged where soil drifting is a problem.** ***Summer application:*** On summerfallow between June 1st to September 1st. ***Special instructions for Lentils:*** Not recommended for spring application. Both incorporations of Triflurex must be done in the fall. Shallowly till and pack the soil in the spring to ensure a firm seedbed and an accurate depth for seeding.
7. HOW TO APPLY:
   With: Ground equipment
   Rate: ***Spring Application:*** (a) 810 mL/ac on sandy soils less than 6% organic matter. (b) 1.1 L/ac on medium or heavy textured soils, 6-15% organic matter, and low to medium wild oat infestations. ***Fall Application:*** (a) 1.1 L/ac on sandy soils less than 6% organic matter. (b) 1.4 L/ac on medium or heavy textured soils, 6-15% organic matter, and low to medium wild oat infestations. ***Summer Application***: June 1-Sept. 1. 1.7 L/ac on all soils.
   Water Volume: 40 L/ac
   Incorporation: First incorporation at a right angle must be done within 24 hours of application. A tandem disc, discer or field (vibra shank) cultivator are recommended for incorporating to 8-10 cm. To get the best mixing action, operate the disc implement at 6-10 km/h and the cultivator at 10-13 km/h.
   Pressure: 275 kPa
8. SPRAYING TIPS: (a) Use on soils with less than 20-25% straw cover. On stubble, chop and thoroughly mix residues and weed growth into the soil before application.
   (b) A tandem disc mixes best on stubble or poor condition soils (crusted, lumpy or wet). Fall application should be followed with 2 incorporations at right angles, before freeze-up. This or a summer application should be preceded by a light spring tillage to a 5-8 cm depth before seeding.
   (c) Do not apply on soils that are wet, in poor tilth, or contain 15% or more organic matter.
   (d) To avoid concentrating wild oat seeds below the treated layer, do not plow land prior to Triflurex application.
   (e) Do not apply with air seeder as it gives non-uniform seeding depth and patchy germination.
9. HOW IT WORKS: Kills seedlings as they germinate. Inhibits cell division in actively growing points of the root and shoot.
10. EXPECTED RESULTS: ***Weeds:*** Most weeds die before emerging. Weeds will exhibit swelling in coleoptile region, stubby, thick primary root development and lack of secondary roots, which leads to death due to inadequate moisture obtaining ability. ***Crop:*** Seed flax into a well packed warm moist seedbed. Do not seed deeper than 4 cm.
11. EFFECTS OF RAINFALL: No effect once Triflurex is incorporated into the soil.
12. MOVEMENT IN SOIL: None.
13. GRAZING AND CROPPING RESTRICTIONS: None. ***Crop Use After Hail:*** No restrictions ***Succeeding Crops:*** Normally, carry over will not harm crops grown in rotation. As a precaution, oats, sugar beets and small seeded annual grasses should not be grown in rotation following a trifluralin treated crop. Drought conditions in year of treatment may result in higher levels of carry-over into the next year. To avoid wheat injury, seed less than 7 cm deep into a warm moist seedbed.
14. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (10,000). In clean water, fish are very sensitive, but in run off or muddy water, it binds to soil particles and large amounts can be tolerated by fish. Non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention.
16. STORAGE: Do not store below 5°C. If stored below 5°C, bring the contents to 15°C for 24 hours and shake well before using. Do not store near heat, spark or open flame.

TROPOTOX (MCPB)
May and Baker

1. FORMULATIONS: Liquid - 400 g/L - 8 L.
2. REGISTERED MIXES: None
3. CROPS: Field peas (8.4)
4. WEEDS CONTROLLED:

buttercup, tall	lamb's-quarters(8.5)	plantain	smartweed, annual
dock, curled	mustard (ball, wild, wormseed)(7.5)	purslane	sow-thistle, annual
flixweed	pigweed, redroot (7.9)	ragweed	stinkweed (6.7)
hemp-nettle			

5. WEEDS SUPPRESSED: Canada thistle (5.4), field bindweed (3.2), shepherd's-purse (4.0).
6. WHEN USED: Peas - 3-6 expanded leaves.
7. HOW TO APPLY:
   With: Ground equipment.
   Rate: 1.4-1.7 L/ac
   Water Volume: 60-80 L/ac
   Pressure: 275 kPa
8. SPRAYING TIPS: Apply in warm weather when weeds are actively growing. Provides only top growth control of Canada thistle and field bindweed.
9. HOW IT WORKS: Systemic, absorbed by leaves and stem. Selectivity is based on ability of some plants to convert MCPB to MCPA.
10. EXPECTED RESULTS: ***Weeds:*** begin to twist within 2-10 days, turn brown and die within 2-3 weeks. ***Poor results may be expected if:*** water volume is incorrect or weeds too mature. ***Crops:*** If peas are beyond proper stage or are under drought or disease stress, damage may occur.
11. EFFECT OF RAINFALL: Rainfall before spray has dried on leaves will decrease activity.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: None listed.
14. TOXICITY: Slightly high acute oral mammalian toxicity; oral LD_{50} rats (mg/kg) = (500). Non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Heated storage required.

TROPOTOX PLUS (MCPB + MCPA)

May and Baker

1. FORMULATIONS: Water soluble solution 375 g/L MCPB + 25 g/L MCPA; 8 L.
2. REGISTERED MIXES: None
3. CROPS: Spring wheat (8.9), barley (8.8), oats, fall rye, seedling clover (wild white, white Dutch, Ladino, alsike (7.2) and red), field peas (8.1), pasture, field corn.
   Underseeding: For clover, can be used on a cereal companion crop.
4. WEEDS CONTROLLED:

bindweed, field (3.2)	knotweed	purslane	sow-thistle, annual (5.4)
buttercup, tall	lamb's-quarter (8.2)	ragweed	stinkweed (7.5)
dock, curled	mustard (ball, wild, wormseed)(7.9)	shepherd's-purse (5.0)	thistle (bull, Canada (6.1))
hemp-nettle (5.9)	pigweed, redroot (8.3)	smartweeds, annual (5.1)	

5. WEEDS SUPPRESSED: Not applicable.
6. WHEN USED: ***Cereals:*** 2 leaf to flag leaf stage. ***Clover:*** 1-4 true leaf stage. ***Peas:*** 3-6 expanded leaves. ***Pasture:*** after grazing or cutting. ***Corn:*** 45 cm high but before tasseling begins, with drop nozzles. ***Weeds:*** seedling stage.
7. HOW TO APPLY:
   With: Ground equipment
   Rate: 1.1-1.7 L/ac depending on weeds to be controlled.
   Water Volume: 60-80 L/ac
   Pressure: 275 kPa
8. SPRAYING TIPS: Spray in warm weather when plants are actively growing.
9. HOW IT WORKS: A systemic herbicide absorbed by leaves and stems, translocated to actively growing regions, disrupts cell division, ceases cell growth and interferes with respiration and food reserves. Selectivity based on ability of plant to efficiently convert MCPB to MCPA.
10. EXPECTED RESULTS: ***Broad-leaved weeds:*** Should be dead within 2-3 weeks of treatment. ***Poor results may be expected if:*** water volume is incorrect or weeds are too mature.
11. EFFECTS OF RAINFALL: Rainfall before the foliage has dried from the spraying may decrease activity.
12. MOVEMENT IN SOIL: Not applicable.
13. GRAZING AND CROPPING RESTRICTIONS: None listed.
14. TOXICITY: Slightly high acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (500). Non-toxic to bees.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to avoid exposure. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
16. STORAGE: Store in heated area.

VELPAR (hexazinone)
DuPont

1. FORMULATIONS: Soluble powder - 90% hexazinone - 25 kg pack. Liquid - 24% hexazinone - 3.78 L jugs.
2. REGISTERED MIXES: None.
3. CROPS: Non-crop land only. An industrial herbicide for total vegetation control. Woodland plantations.
4. WEEDS CONTROLLED: Annual and perennial grasses, broad-leaved weeds and some woody species.
5. WEEDS SUPPRESSED: None.
6. WHEN USED: Apply just before or when weeds are actively growing. Do not apply to frozen ground.
7. HOW TO APPLY:
   With: Fixed boom sprayer, handgun, back pack sprayers, a watering can for smaller areas, or a spot gun.
   Rate: For contact top growth or short term (3 months) control - apply 1.1-1.8 kg/ac as a foliar spray. For more than 1 season control, apply 1.8-3.6 kg/ac as a foliar spray. The higher rates of application should be used on fine textured soil (clay or clay loam) or on soils containing more than 5% organic matter.
   Water Volume: When applying with a handgun use a minimum of 650 L/ac of spray solution.
8. SPRAYING TIPS: See "Soil Sterilants" page 4.
9. HOW IT WORKS: A systemic herbicide readily absorbed through the roots and foliage and translocated upwards. Inhibits photosynthesis.
10. EXPECTED RESULTS: Plants become chlorotic soon after treatment and then die. Rainfall will increase efficacy. ***Poor results may be expected if:*** there is inadequate application rate, weed growth too mature, insufficient rainfall or application on areas subject to severe soil erosion.
11. EFFECTS OF RAINFALL: Rainfall less than 4 hours after application may affect the contact activity.
12. MOVEMENT IN SOIL: Velpar moves downward in the soil to the root zone of woody species.
13. GRAZING AND CROPPING RESTRICTIONS: None. ***Succeeding Crops:*** Velpar is a non-selective residual herbicide. Only used on non-crop land.
14. TOXICITY: Low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (1,690). May cause some eye irritation. Slightly toxic to fish.
15. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2). IF IN EYES or ON SKIN - use standard first aid measures (see page 3).
16. STORAGE: Store in a cool, dry place.

PLANT GROWTH REGULATOR

CERONE (ethephon)

Union Carbide

1. FORMULATIONS: Liquid solution, 480 g/L; 5 L.
2. REGISTERED MIXES: None. ***Mixing Instructions:*** To 1/2 required amount of water add Cerone, start agitation, then add the rest of water. Maintain gentle agitation at all times.
3. CROPS: Barley - Bedford, Bonanza, Galt and Johnston varieties ***only***.
4. WHEN USED: From early flag leaf emergence to swollen-boot stage. Do not apply after the awns have emerged.
5. HOW TO APPLY:
   With: Ground or aircraft. Do not use control droplet applicators, Spra-Coupes or floaters.
   Rate: 200-340 mL/ac
   Water Volume: Aircraft - minimum of 20 L/ac; Ground - 40-120 L/ac.
   Pressure: Ground - 275 kPa
   Nozzles: Do not apply with flood jet nozzles.
6. SPRAYING TIPS: Use the higher rates on crops that are heavily fertilized, have ample moisture and are prone to lodging. Use the lower rate unless lodging conditions are expected to be severe. DO NOT APPLY TO CROPS WHICH ARE UNDER STRESS as severe yield reductions may result. To prevent permanent staining of painted surface, wash all equipment at end of each spray operation.
7. HOW IT WORKS: Uptake primarily through the leaves and stem. Very little translocation throughout the plant.
8. EXPECTED RESULTS: Cerone acts by releasing ethylene in the plant tissues which reduces cell elongation and plant height, usually by 2-15 cm. Cerone applications also strengthen the straw. An occasional delay in maturity may occur. This is normally not greater than 5 days and is generally less than that caused by lodging.
9. EFFECTS OF RAINFALL: Rainfall within 5 hours will decrease activity.
10. MOVEMENT IN SOIL: Not applicable.
11. GRAZING AND CROPPING RESTRICTIONS: ***Drift:*** Avoid drift onto nearby crops as modifications in growth may result. ***Grazing Restrictions:*** Do not graze treated green crop. Treated straw may be fed to livestock. Do not apply within 35 days of harvest. ***Succeeding Crops:*** No restriction.
12. TOXICITY: Very low acute mammalian toxicity; oral LD_{50} rats (mg/kg) = (4,229). Cerone is highly acidic and will cause skin irritation. Over exposure may cause nausea. Inhalation may cause irritation of mucous membranes. Eye contact may cause eye damage.
13. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) plus rubber gloves, goggles, and respirator when handling Cerone. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for eyes. IF SWALLOWED - do NOT induce vomiting; get immediate medical attention. Treatment is symptomatic.
14. STORAGE: Do not freeze.

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CHEMICAL INSECT CONTROL IN ALBERTA

The degree of infestation and the severity of insect damage vary drastically from area to area and season to season. Some pests, such as grasshoppers and bertha armyworms, require control during periods of abundance which may last from one to several years. Other pests are perennial; sugar beet root maggot, for example, is controlled by the application of a granular insecticide at planting.

To insure proper use of insecticides identify the pest, learn its biology, check your fields and do not panic when you see an insect in your crop. Keep in touch with extension personnel to obtain information on pending pest problems and keep in mind the previous years' problems so you are prepared for changes in insect population levels.

Chemical Control

Attention to the following points should lead to more effective control. Insecticides will kill the pest insect if applied properly at a stage when the pest is susceptible. An application that is made too early or too late in the life cycle may not provide adequate control and would be wasteful. Follow label instructions for proper application and learn the biology of the pest. Base control decisions on the amount of foliage, weather conditions, age and size of the insect and dosage required. Most insecticides have limited residual control properties when applied to foliage; if insects are moving into crops or emerging over an extended period, several applications in the same season may be necessary.

Safety

In general, insecticides are more toxic to humans, wildlife, fish, bees and other non-target organisms than herbicides. Follow label directions for safety precautions associated with application of each insecticide. Refer to pages 2-8 for general information on pesticide toxicity, exposure, safety precautions, protective equipment, symptoms, first aid, poison control centres, and disposal. Specific information on safety is included with each insecticide.

Bee Safety

Honey bees and other pollinators are susceptible to most insecticides. If applications are made to weeds or crops in bloom, severe pollinator mortality may occur. To reduce this risk, apply insecticides in late evening (most preferred) or early morning when bees are not flying. Advise beekeepers in the area to be sprayed at least 48 hours before application so they can protect their bees. Never allow insecticide spray to drift directly onto an apiary site. Do not apply insecticides to water bodies which may be used by bees.

Livestock and Residues

The number of days between application of an insecticide and harvesting, feeding to livestock, or grazing is given on the label. These restrictions must be followed to prevent illegal residues and eliminate hazards to consumers. Follow label instructions.

The Manual

This manual includes only the major insecticides registered for use in Alberta. Not all insects controlled are listed for each pesticide; see the labels for complete listings.

AMBUSH, POUNCE (permethrin)

Chipman / Chemagro

1. **FORMULATIONS:** Emulsifiable concentrates - Ambush (500 g permethrin/L). Pounce (384 g permethrin/L). Ambush: 1% granular and 25% wettable powder.

2. **HOW IT WORKS:** Works by contact and as a stomach poison on a wide range of pests. Good residual activity. No systemic or fumigant activity.

3. **HOW TO APPLY:**
   With: Ground equipment only.
   Rate:

Crop	Insect	Formulation	Qty/ac
barley, corn, oats, rye, wheat, canola, mustard, sunflower, sugar beets, sweet corn(1)	Cutworms (army, pale western, red-backed)	Ambush 500 EC	57-120 mL
sweet corn(1)	Corn earworm, European corn borer	Ambush 500 EC Ambush 1% Pounce	81-111 mL 4 kg 110-150 mL
potato(1)	Colorado potato beetle, potato flea beetle, potato leafhopper, tarnished plant bug	Ambush 500 EC Pounce	57-81 mL 75-110 mL

   NOTE: Pre-harvest interval (days) given in brackets after crop.
   Water Volume: Corn applications, use: with Ambush 130-180 L/ac; with Pounce 140-180 L/ac
   Potato application, use sufficient water to obtain thorough coverage of foliage.

4. **APPLICATION TIPS:** Use the higher rate for heavy infestations (anticipated or actual), or when adult insects are present, or when foliage is dense, or (for cutworms) when soil is dry.
   Corn - spray no later than when first feeding damage is seen on foliage. For control of corn earworm, direct spray to ensure coverage of ears and silk. For European corn borer control, consult with provincial agriculturalist for proper timing of spray.

5. **GRAZING RESTRICTIONS:** Do not feed any crop treated with permethrin to livestock.

6. **TOXICITY:** Acute oral LD_{50} rats (mg/kg) = (430-4,000). Severe eye irritant. Toxic to bees.

7. **PRECAUTIONS, FIRST AID:** Wear protective equipment to avoid contact with skin and eyes. Do NOT inhale spray mist. Do not spray when bees are foraging. Keep product away from fire, open flame, electric light bulbs and other sources of heat. ***First Aid:*** IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - Do NOT induce vomiting or administer liquids; product contains petroleum distillates. Get medical attention immediately.

8. **DECONTAMINATION AND DISPOSAL:** Rinse empty bottle 3 times with clean water, each time disposing of rinse in the spray tank. Break rinsed bottle and cap and dispose of in garbage.

COUNTER (terbufos)
Cyanamid

1. FORMULATIONS: Granules - Counter 5-G (5% terbufos), Counter 15-G (15% terbufos).
2. REGISTERED MIXES: 5G may be mixed with fungicide treated seed.
3. HOW IT WORKS: Terbufos is a systemic, organophosphorus insecticide with effective initial and residual activity.
4. HOW TO APPLY:
   With: Ground equipment.
   Rate:

Crop	Insect	Formulation	kg/ac
Canola, mustard	Flea beetle	5-G	2.2-4.5
Sugar beet	Sugar beet root maggot, wireworm	15-G	45 g/100 m row (minimum row spacing of 50 cm)

   Incorporation: Canola and mustard - carefully blend seed and granules together using a mechanical mixer or stirring with a stick in the drill box. Sugar beets - apply in furrow, 5-8 cm behind the seed drop zone after some soil has covered the seed.
5. APPLICATION TIPS: NOTE: If extreme infestations are anticipated use the higher rate. Apply at planting time only. Do not place 15-G granules in direct contact with seed. When a seed treatment is also used - mix the seed treatment with seed, then mix granules with treated seed.
6. GRAZING RESTRICTIONS: Sugar beet tops and beet pulp may be fed to livestock after harvest.
7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (1.6).
8. PRECAUTIONS, FIRST AID: Rapidly absorbed through skin. Repeated inhalation or skin contact may, without symptoms, progressively increase susceptibility to poisoning. While transferring from package to equipment, wear a clean cap and gloves (rubber or cotton). If cotton gloves are used, they must be laundered or discarded after each day's use. Clothes and rubber gloves should be washed with soap and water after each use. Do not wear the same gloves for other work. Wash thoroughly with soap and water before eating, drinking or smoking. Bathe at the end of the work day, and change outer clothing.
   DO NOT BREATHE DUST - While emptying bags into equipment, pour downwind and allow as little free fall as possible. Do not pour at face level and do not allow dust to reach the breathing zone. Sweep up and bury spillage whether it occurs indoors or in the field. Once a bag has been opened, use it completely or bury the remainder. Make sure that the hoppers of equipment are emptied while still in the field. Cover granules that may be exposed on the ends of the treated rows, turns and field loading areas. Keep all unprotected persons out of the operating areas. ***Symptoms of poisoning:*** weakness, headache, tightness of chest, blurred vision, non-reactive pinpoint pupils, salivation, sweating, nausea, vomiting, diarrhea or abdominal cramps.
   First aid: CALL A PHYSICIAN AT ONCE IN ALL CASES OF SUSPECTED POISONING. IN EMERGENCY endangering life or property, call collect, day or night, 1-416-356-8310. ATROPINE IS AN ANTIDOTE. Consult your physician about obtaining a supply of 0.65 milligram tablets for emergency use. If symptoms include blurred vision, stomach cramps or tightness in chest, do not wait for a physician but take 2 tablets at once. Do not take atropine unless symptoms of poisoning have occurred. Anyone who has been sick enough to have taken atropine must be seen by a physician as soon as possible. IF INHALED - remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for eyes. IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
9. DECONTAMINATION AND DISPOSAL: ***Decontamination Solution:*** Into 10 L of water slowly and carefully add in sequence 130 g detergent followed by 525 g caustic soda (lye) and finally 1.2 litres of commercial bleach (sodium hypochlorite). Handle and use the solution with great care. Do not add water to dry lye. If spill occurs on floor areas, use a sweeping compound to clean up. Decontaminate the waste with decontamination solution. Wash floor with decontamination solution and rinse well with clean water. Clean up solution and rinse water with absorbent materials such as sawdust, sweeping compound, rags, etc. Dispose of waste and rinsings by burying in a non-crop, non-graze area away from all water supplies. If spill occurs on the ground collect the material and dispose of it as above. Treat affected area with decontamination solution and cover with clean soil.

CYGON (dimethoate)

Cynamid/Chipman/Peacock Industries

1. FORMULATIONS: Emulsifiable concentrates - Cygon 480E, Cygon 4-E, Cygon Hopper-Kill and SYB-TEM 480 EC (480 g dimethoate/L). Hopper Stopper Bran Bait 5.2% (see Bait directions).

2. NUMBER OF APPLICATIONS: Repeat as necessary.

3. HOW IT WORKS: Dimethoate is a broad-spectrum, systemic and contact, organophosphate insecticide and acaricide.

4. HOW TO APPLY:
   With: Ground or air equipment.
   Rate:

Crop	Insect	mL/ac
barley, oats	grasshoppers,	180-400
rye, wheat	thrips	400
alfalfa, clovers,	aphids, young grasshoppers,	180
pastures, waste areas	leafhoppers, lygus bugs, plant bugs, alfalfa weevil larvae	
	adult (winged) grasshoppers	340-360
sweet clover	sweet clover weevil	340-400
canola	aphids, grasshoppers	340-360
potato (7)	aphids, leafhoppers	225-450

   NOTE:
   (a) Check each specific label to insure the insect is included on that label.
   (b) Grasshopper, sweet clover weevil control: when a range of rates is given, use lower rate for young insects, minor infestations or sparse foliage and higher rate for adult insects (winged grasshoppers and beetles), severe infestations or dense foliage.
   Water Volume: Use 18 L/ac for good coverage. Potatoes - a minimum of 80 L/ac.
   Protective Equipment: Wear a respirator when exposure to spray cannot be avoided; wear goggles, rubber gloves and coveralls when handling concentrate.

5. APPLICATION TIPS: Apply when insects or damage first appears. Not suitable for application in oil.

6. GRAZING AND CROPPING RESTRICTIONS: Remove cattle prior to spraying. Do not graze dairy cattle for 48 hours after application. Pre-harvest interval is dependent upon the rate applied. When using 170-220 mL/ac, do not harvest or graze within 2 days. When using 340-360 mL/ac, do not harvest or graze forages within 7 days, on canola and grains within 21 days. When using 360-450 mL/ac, do not harvest or graze within 28 days. Do not harvest potatoes within 7 days.

7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (320-380).

8. PRECAUTIONS, FIRST AID: Wear protective equipment to avoid contact with skin and eyes. Do not inhale spray mist. Use in adequately ventilated area. Do not use or spill or store near heat or open flame. Do not use when bees are foraging. ***Symptoms of poisoning:*** anorexia, nausea, vomiting, pinpoint pupils, excessive salivation, muscle twitching, convulsions or coma.
   First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention in all cases.

9. STORAGE: Store between 5°C and 30°C, away from feed and food.

10. DECONTAMINATION AND DISPOSAL: If accidental spillage should occur, scrub contaminated area immediately with a strong laundry soap solution or use household lye - detergents are not satisfactory for this purpose. Repeated scrubbings are necessary on plain wood surfaces. ***Disposal:*** Drain container completely into spray tank. Then rinse container at least 3 times, filling at least 1/4 full with water each time and draining into spray tank after each rinse. Crush or break empty container and bury it with at least 0.5 m of cover and away from water supplies.

HOPPER STOPPER BRAN BAIT

Application: Bait is applied dry and broadcasted evenly to control grasshoppers Apply no more than once a week for heavy infestations and no more than once every 2 weeks for moderate to low infestations. Do not contaminate bodies of water, food or feed. ***Rate:*** 0.8-1.2 kg/ac. Non-toxic to pollinators if applied as directed. ***Beef Cattle*** do not have to be removed during treatment. ***Dairy Cattle:*** do no graze or harvest forage for 48 hours. ***Grain Crops:*** do not harvest for 21 days after treatment. ***Disposal:*** Do NOT burn empty bags.

DECIS (deltamethrin)
Hoechst

DANGER POISON

1. FORMULATIONS: Emulsifiable concentrate - Decis 5 EC (50 g/L).
2. HOW IT WORKS: Deltamethrin is a non-systemic, synthetic pyrethroid which works by contact and ingestion.
3. NUMBER OF APPLICATIONS: Maximum of 3 applications per year. Only 1 application to a field by air per year.
4. HOW TO APPLY:
   With: Ground equipment (G) or Air (A).
   Rates:

Crop	Insect	mL/ac
Alfalfa (seed production only)(G)	Alfalfa weevil	100
	Lygus bugs	80-100
Canola, mustard (both 14)(G or A)	Flea beetles (Bertha armyworm, clover cutworm)	40-60
Potato (23)(G or A)	Colorado potato beetle, tarnished plant bug, potato flea beetle	40-60
Wheat, barley, flax, oats (all 40)(G or A)	Cutworms	80
	Grasshoppers	40-60

   NOTE:
   (a) Pre-harvest interval (days) given in brackets at crop.
   (b) Use higher rate for severe infestation, on dense foliage, or when adult insects are present.
   Water Volume: Ground application: alfalfa - 40-120 L/ac; canola and mustard - 40 L/ac; potatoes - 80-200 L/ac; cereals and flax - 40-80 L/ac. Aerial application: 4.4-8.8 L/ac.
   Pressure: Ground application: 275 kPa. Aerial application: no less that 200 kPa.
5. APPLICATION TIPS: Do not spray under a strong temperature inversion, or when temperature exceeds 25°C. Aerial application: leave 100 m border between edge of treated fields and environmentally sensitive areas. Do no use raindrop nozzles. Do not mix product with any other chemicals, additives or fertilizers. With severe flea beetle and grasshopper infestations, spray fence rows and a 15 m strip into adjacent summerfallow and cropped fields. Apply to young (non-flying) grasshoppers for best results. Apply when insects or damage first appears.
6. GRAZING RESTRICTIONS: Do not graze treated fields. Do not feed treated crops to livestock, including crops damaged by hail.
7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (395). Severe eye and skin irritant.
8. PRECAUTIONS, FIRST AID: Wear protective gear to avoid contact with skin and eyes. Do not inhale. Keep away from fire, open flame and other sources of heat. Do not apply when bees are foraging. ***Symptoms of poisoning:*** neurological dysfunction, such as convulsion with severe poisoning.
   First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Treat irritated skin area with Nivea cream. IF SWALLOWED - Do NOT induce vomiting or administer liquids. This product contains xylene. Get medical attention.
9. STORAGE: Do not store below freezing. Do not store near feed or food.
10. DECONTAMINATION AND DISPOSAL: Rinse empty containers with clean water at least 3 times, each time adding rinse water to spray tank. Crush rinsed containers and either bury at least 50 cm deep in loamy soil in a non-crop, non-graze area away from all water supplies or deliver to an approved land fill.

DIAZINON (diazinon)

Ciba-Geigy

1. FORMULATIONS: Wettable powder (WP) - Diazinon 50W (50% diazinon). Emulsifiable concentrate (EC) - Diazinon 500 (500 g diazinon/L).
2. REGISTERED MIXES: When using WP as a seed treatment for corn and sugar beets, mix with a fungicide (75% Captan or 75% Thiram).
3. HOW IT WORKS: Diazinon is a non-systemic, organophosphate insecticide which works by contact and ingestion. Diazinon deteriorates rapidly in solution and in containers once opened.
4. NUMBER OF APPLICATIONS: Repeat as necessary.
5. HOW TO APPLY:
   With: Ground equipment.
   Rate:

Crop	Insect	Formulation	Qty/ac
Potato (14)	Aphids, Colorado potato beetle, flea beetles, leafminers, leafhoppers	WP	0.5 kg
		EC	0.5 L

   NOTE: Pre-harvest interval (days) given in brackets after crop.
6. APPLICATION TIPS: Spray when insects first appear.
7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (250). Toxic to bees.
8. PRECAUTIONS, FIRST-AID: Wear protective gear to avoid contact with skin or eyes - do not inhale spray mist. Do not apply to crops in bloom. ***Symptoms of poisoning:*** headaches, giddiness, blurred vision, nervousness, weakness, nausea, cramps, diarrhea, discomfort in the chest, sweating, pinpoint pupils, tearing, salivation, vomiting, uncontrolled muscle twitching, convulsions, or coma. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
9. STORAGE: Do not store or use EC near heat or open flame. Flash point 27°C.
10. DECONTAMINATION AND DISPOSAL: ***Spills on concrete floors***: surround and cover spill with a granular carrier such as Attaclay, (cat litter). Allow carrier to absorb the liquid, then shovel into a container for disposal by burying. Wash the floor with a weak lye solution to remove any trace of pesticide. ***Spills on wooden floors:*** use same procedure as for concrete floor but repeat washing until odor disappears.
    Decontaminate equipment and empty containers by thoroughly rinsing with water; dispose of rinsings by burying in non-crop land away from water supplies. Crush, break or puncture empty containers and bury with rinsings or deliver them to sanitary landfill dumps.

DYLOX (trichlorfon)
Chemagro

1. FORMULATIONS: Soluble Powder - (80% trichlorfon by weight). Solution - (420 g trichlorfon/L)

2. HOW IT WORKS: Trichlorfon is an organophosphate insecticide which works by contact and ingestion.

3. NUMBER OF APPLICATIONS: Alfalfa - 1 per cutting. Barley, flax, oats, wheat - repeat as necessary prior to head emergence but not after flowering to flax; 1 additional application may be made to barley, oats and wheat after heads emerge from sheath. Canola, sugar beets - repeat as necessary. Corn (field, sweet) - maximum of 3 per season with either formulation.

4. HOW TO APPLY:
With: Ground or aircraft equipment.
Rate:

Crop	Insect	Powder g/ac	Liquid L/ac
Alfalfa (14)	Alfalfa caterpillar	210-280	0.4-0.6
	alfalfa webworm	140-160	0.28-1.1
	beet armyworm, variegated cutworm	280-610	0.6-1.1
	Lygus bugs, stink bugs, tarnished plant bug	610	1.1
Barley, flax, oats, wheat (all 21)	Armyworms (common and true, western yellow-striped)	280	0.6
	Beet webworm, variegated cutworm	280-610	0.6-1.1
	Bertha armworm	610	1.1
Canola (21)	Beet webworm	280	0.6
	Diamondback moth	610	1.1
Corn (field, sweet)(0)	Armyworms, cutworms	280-610	0.6-1.1
Sugar beet (14)	Beet webworm	140-280	0.3-0.6
	Dipterous leaf miners, variegated cutworm	280-610	0.6-1.1
	Beet armyworm	610-910	1.1-1.6

NOTE:
(a) Pre-harvest or pre-grazing interval (days) given in brackets after crop.
(b) Where a rate range is specified, use the low rate for immature insects, light infestations or sparse foliage.
(c) Exception: webworm control on sugar beets, use higher rate with low volume aerial application.

5. APPLICATION TIPS: Powder dissolves readily in water and is suitable for use in all power-operated ground sprayers and aircraft sprayers. To dissolve, pour the required amount into full amount of water and then agitate. Use immediately after mixing. Soluble powders should be used in sprayers equipped with 0.3 mm or larger screens. If 0.15 mm screens are used, some screen clogging may occur. Trichlorfon is a selective insecticide: beneficial insect species are less affected. This selective advantage is lost when product is used in conjunction with or alternated with non-selective pesticides. *Corn:* for early applications to control armyworms and cutworms, spray when plants are 7.5-30 cm high; direct the spray to the lower portions of the plant.

6. GRAZING RESTRICTIONS: Sugar beets - do not feed tops harvested within 28 days of treatment.

7. TOXICITY: Acute oral LD_{50} rate (mg/kg) = (144).

8. PRECAUTIONS, FIRST AID: Wear standard protective clothing (see page 2) to protect skin and eyes. Do not inhale spray mist. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.

9. STORAGE: Store the liquid formulations above 0°C and away from excessive heat and open flame. Store in an area specially designated for pesticides. Do not store near any material intended for use of or consumption by humans or animals.

FURADAN (carbofuran)
Chemagro

DANGER POISON

1. FORMULATIONS: 10G and CR-10 (10%.carbofuran). Flowable - (480 g carbofuran/L).

2. REGISTERED MIXES: Flowable formulation may be tank-mixed with phenoxy ester or amine herbicides and should be used only on crops listed on both labels. Compatible with most fungicides. Do not mix with Bordeaux mixture or hydrated lime.

3. HOW IT WORKS: Carbofuran is a broad-spectrum, systemic, carbamate insecticide, acaricide and nematicide.

4. NUMBER OF APPLICATIONS: Granular - 1 per season. Flowable: Oilseeds - for flea beetle control, 1 application at 110 mL/ac or 2 applications totalling no more than 110 mL/ac. Grains and forages - 2 applications at 110 mL/ac or, for alfalfa weevil, 1 at 225 mL/ac. Corn - 4 applications for corn borer. Potatoes - repeat as necessary.

5. HOW TO APPLY:

(a) Granular

Rate:

Crop	Insect	Formulation	kg/ac
Canola, mustard	Flea beetles	CR-10	1.1
Potato	Colorado potato beetle, potato flea beetle, leafhoppers	10G	13.2 (using 90 cm row spacing or 300 g/100 m of row)
Sugar beet	Sugar beet root maggot	10G	3.4

NOTE: - Use the higher rate if a severe infestation is anticipated.

Incorporation: ***Canola, mustard:*** for seed drill application only; not valid for application with discer seeders. Efficacy can be reduced by harrowing after seeding. Mix granules and seed thoroughly. Check for accurate calibration. ***Potatoes:*** apply as a 10 cm wide band into seed furrow or drill into the soil 10 cm on each side of row and 5 cm below seed. ***Sugar beets*** apply directly into seed furrow at same depth as seed or slightly above seed. Do not mix seed, fertilizer and insecticide in same hopper.

(b) Flowable

With: Ground or aircraft equipment.

Rate:

Crop	Insect	mL/ac
Alfalfa(7)	Alfalfa weevil	225
Alfalfa(1); barley(21); canola(60); corn (sweet(7), field(3)); flax(21); mustard(21); oats(21); pasture(1); sweet clover(28); wheat(21)	Grasshoppers	110
Canola(60), mustard(21)	Flea beetles	60-110
	Red turnip beetle	110
Corn (field, silage, sweet)(7)	European corn borer	445
Potato(7)	Any of: aphids, potato flea beetle, potato leafhopper or tarnished plant bug alone or in combination with Colorado potato beetle.	445
Potato(7)	Colorado potato beetle	225

NOTE:

(a) Pre-harvest or pre-grazing interval (days) given in brackets after crop.

(b) Canola - use the higher rate for severe infestations.

(c) Potatoes - use 690 mL/ac if large numbers of aphids are present.

Water Volume: Ground application - not less than 40 L/ac, use sufficient water for thorough coverage. Aerial application - not less than 20 L/ac. Potatoes - use 325-405 L/ac at a minimum pressure of 275 kPa.

6. APPLICATION TIPS: Check the label for calibration of various types of granular applicators. If seed decay, seedling blight or damping-off diseases are a problem, treat seed with a recommended fungicide. Canola and mustard may also require a foliar treatment after seeding with granules. Check fields shortly after emergence. Alfalfa - apply when 25% of tips show feeding damage by alfalfa weevil. In general, apply foliar sprays when insects or feeding damage first appears. Boom sprayers - equip with hydraulic or mechanical agitation and 0.3 mm screens; remove any felt filters.

7. GRAZING RESTRICTIONS: Sugar beet tops and pulp may be fed to livestock without causing residues in milk or meat.

8. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (11).

9. PRECAUTIONS, FIRST AID: Wear coveralls and goggles at all times. NEVER handle product with bare hands. Use rubber or neoprene gloves, do NOT use leather gloves. Change clothes each day. Wash clothes in detergent, bleach and hot water. Take a bath at the end of each day. Do not breathe spray mist or dust. ***Symptoms of poisoning:*** blurred vision, nausea, excessive perspiration, weakness, headache, light-headedness, constriction of pupils, cramps, salivation and vomiting. ***First Aid:*** IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Repeat until vomit is clear. Victim should be lying face down or on the side with head below foot level. Secure medical attention immediately.

10. STORAGE: Protect flowable from freezing.

GASTOXIN, PHOSTOXIN (phosphine)

Sanex Inc.

1. FORMULATIONS: 3 g tablets (release 1 g phosphine upon decomposition). 0.6 g pellets (release 0.2 g phosphine upon decomposition).

2. MARKETING CATEGORY: Restricted. A permit must be obtained from your local Agricultural Fieldman or Alberta Environment prior to purchase or use of these products.

3. REGISTERED USES: Raw agricultural products, grain, processed foods and feeds.

4. HOW IT WORKS: Phosphine (hydrogen phosphide) is a colourless gas with a carbide-like odour and high volatility. Formulated product consists of aluminium phosphide, ammonium bicarbonate, urea and paraffin. Upon exposure to air, the ammonium bicarbonate breaks down to form ammonia (a pungent, warning gas) and carbon dioxide (a fire suppressant). Within 1-4 hours, depending on temperature and humidity, the product begins to release phosphine and decompose. The effectiveness of fumigation is primarily dependent upon temperature, tightness of seal, the type of storage space, exposure time and dosage.

5. INSECTS CONTROLLED:

almond moth	dermestids	granary and rice weevils	Mediterranean flour moth
Angoumois grain moth	dried fruit moth	Indian meal moth	raisin moth
bean weevil	flat or rusty grain beetle	khapra beetle	saw-toothed grain beetle
cadelle	flour beetles	lesser grain borer	tobacco moth

6. HOW TO APPLY:

Rate: Raw agricultural commodities, grain and bulk animal feeds: 4-6 tablets/m^3 (60-180/1000 bu.), or 5-10 pellets/m^3 (120-300 pellets/1000 bu.).

Processed foods - 16 tablets/10 m^3 (30-60/1000 $ft.^3$) or 6 pellets/m^3 (100-200/1000 $ft.^3$) of storage space.

Exposure Times:	**Commodity temp. °C**	**Exposure time (tablets)***
	over 20	3 days
	16-20	4 days
	12-15	5 days
	5-11	10 days
Do not fumigate	below 5	*Pellets - 1 day less

Protective Equipment: It will be necessary to wear a gas mask if: (a) structure under fumigation must be entered in case of emergency or (b) a structure must be entered to commence aeration procedure. Otherwise, it is not necessary to wear a gas mask when product is applied according to label directions. Wear gloves when handling the product.

7. APPLICATION TIPS: ***General:*** NEVER fumigate alone. Have appropriate gas detection devices available for use as needed. NEVER fumigate any structure or area unless it is unoccupied. Aerate finished food for 48 hours before it is offered to the consumer. ***Fumigating Flat Storages (Quansets, granaries):*** Make certain that the structure is tight enough to be fumigated successfully. Seal structure as needed. Make certain that there are no adjoining structures occupied by man or animals. During fumigant application leave all doors or other openings open to create a cross ventilation. Application can proceed for 2-4 hours or until the odor of phosphine is detected in the overspace. Apply the tablets or pellets by using a probe. Make probes every 4-5 feet horizontally across the grain in both directions. The number of tablets or pellets used per probe is determined by dividing amount of fumigant to be used by number of probings to be made. Fumigant is dropped in the probe at intervals as the pipe is withdrawn from the grain.

A plastic tarp may be pulled over the grain surface following application. This reduces convection currents and increases the effectiveness of the fumigant. Care must be taken to see that the plastic is removed when fumigation is completed (no more than 5-6 days or sweating of grain may occur).

Close and seal all external openings. Placard and lock all entrances. Following the exposure period, open doors and windows creating a cross draft to aid in aeration. Make certain all warning signs are removed when aeration is complete. ***Fumigation of Railcars:*** Boxcars and hopper cars of bulk raw agricultural commodities and animal feeds are fumigated in the same manner as are silos or flat storages. Tablets or pellets may be added to the commodity as it flows into the railcars, placed on the floor of empty car, placed on the surface of commodity, or probed after loading is completed. Processed foods and bagged raw commodities and animal feeds are fumigated by placing tablets or pellets in moisture permeable envelopes or on trays, which in turn are fastened to a substantial support within the car. Care must be taken to see that fumigant or its reacted residue does not come in contact with processed foods.

Close and seal all hatches or doors. Approved warning signs must be must be applied to each door of box cars and near the ladder on hopper cars as well as on top hatch covers. Date signs as to when fumigation commenced and when the car may be opened. Notify the consignee that the car is to be received under fumigation. ***Fumigating Silo Type Storages (Granaries):*** Calculate required number of tablets or pellets based on dosage selected and quantity of commodity to be treated. Open all containers outside the building.

Tablets may be applied to grain on the transfer belt by hand. Pellets are best applied using an automatic pellet dispenser. They may be dispensed into the up leg of elevator from workroom floor, or onto grain as it travels along the transfer belt on bin floor.

8. TOXICITY: Hydrogen phosphide gas is very toxic to all forms of animal life, and exposure to even small amounts should be prevented. Poisoning results from ingestion or inhalation as hydrogen phosphide is not absorbed through the skin. It is also insoluble in water, fats, and oils.

9. PRECAUTIONS, FIRST AID: Open containers only in open air and with the opening pointing away from your face. Wear

gloves when handling the product. Use entire contents of a tube once it is opened. Unopened tubes and resealable flasks may be returned to the locked storage area for later use. Wash hands after use of the product.
NEVER let tablets or pellets come in direct contact with liquid - this causes the immediate release of hydrogen phosphide. NEVER confine the product in small gas proof enclosures such as plastic bags. Such confinement could cause the gas concentration to reach the lower flammability level. Take precautions in areas where copper, brass or gold are present, as corrosion may occur. NEVER fumigate in areas containing electronic or telephone equipment, photographic film or copy paper. It may be possible to remove such items or protect them from exposure to the gas. Suggested exposures should be observed. A shortened exposure period cannot be compensated for by increased dosage. Hydrogen phosphide has great penetrating power and gas may slowly seep through concrete block walls. See that adjoining areas are not used as living quarters during the fumigation period. Hydrogen phosphide does not layer, but expands to fill the available space. Because of its high volatility and penetrating ability, the enclosure being treated must be sealed as tightly as possible if an effective fumigation is to be expected.
Symptoms of poisoning: Severity is dependent on concentration of hydrogen phosphide involved. Mild poisoning results in fatigue, nausea, pressure or pain in the chest, ringing in the ears, and uneasiness. Hydrogen phosphide is not a chronic poison, and these symptoms will readily disappear with rest and fresh air. Greater quantities of gas produce such symptoms as vomiting, stomachache, diarrhea, disturbance in equilibrium, and dyspnea (difficulty in breathing). Very high concentrations quickly cause bluish-purple skin color, agitation, poor muscle co-ordination, sub-normal blood oxygen content, unconsciousness and death. Death can occur very quickly, or be delayed several days as a result of pulmonary edema and collapse, by paralysis of the central respiratory system. In cases of severe poisoning, disturbance in liver and kidney function can also occur.
First aid: Should exposure to hydrogen phosphide be documented or suspected: Remove patient from gas atmosphere to open air. CALL A PHYSICIAN IMMEDIATELY. Have patient lay down, keeping him warm and comfortable. Treat as for shock. Make NO antidotal use of fats, oil, butter, or milk. Do NOT administer atropine as it is contraindicative. Commence artificial respiration if breathing has ceased. When exposure to low concentrations of hydrogen phosphide have been documented or suspected, the individual involved should rest for 24 hours and under no circumstances should he resume any work dealing with fumigation.

10. STORAGE: Tablets and pellets are received in wooden cases containing sealed tubes and cans, or resealable flasks. As long as the tubes, cans or flasks remain intact, the storage life of the product is unlimited. Storage should be in a dry, locked, ventilated area and out of the reach of children and irresponsible persons.

GUTHION (azinphos-methyl)
Chemagro

1. FORMULATIONS: Spray concentrate (SC) - (240 g azinphos-methyl/L).
   Wettable powder (WP) - (50% azinphos-methyl)

2. HOW IT WORKS: Azinphos-methyl is a contact, non-systemic, organophosphate insecticide and acaricide.

3. NUMBER OF APPLICATIONS: One per season on barley, oats, rye, sugar beets, wheat. One per season on alfalfa and clover except 2 per season for sweet clover weevil control or when using rates of 910 mL SC/ac or less. Repeat as necessary on canola and potatoes.

4. HOW TO APPLY:
   With: Ground or aircraft equipment.
   Rate:

Crop(*)	Insect	Liquid Qty/ac	Powder Qty/ac
Alfalfa (21), Clover (21)	Alfalfa plant bug, alfalfa weevil, aphids, grasshoppers, leafhoppers, lygus bugs, sweet clover weevil	0.9-1.4 L 0.425-0.7 L 910 mL	445-710 g 445 g
Canola (30)	Diamondback moth Flea beetles	225-505 mL 110-225 mL	110-225 g 60-110 g
Canola (30)	Red turnip beetle	225-345 mL	110-170 g
Cereals (30)	Grasshoppers	0.425-0.7 L	
Potato (7)	Aphids Colorado potato beetle	1.4 L 510-710 mL	710 g 225-345 g
Potato (7)	Flea beetle, leafhoppers, spittle bug, tarnished plant bug	0.9-1.4 L	445-710 g
Sugar beet (100)	Flea beetles	110 mL	60 g

   *NOTE:
   (a) Pre-harvest interval (days before cutting for food, feed or forage) given in brackets after crop.
   (b) Rate range - use the lower rate on immature insects, light infestations or sparse foliage.
   Water Volume: Minimum of 32 L/ac with ground equipment and 16 L/ac with aerial application. Alfalfa weevil - use 60-80 L/ac on heavy growth.
   Nozzles: When spraying canola and sugar beets, wettable powder may be applied using any commercial tractor, or drawn or self-propelled field sprayer provided it is equipped with the following:
   (a) nozzle tips no finer than 6502, 8002 or TK2 with nozzle screens no finer than 0.3 mm. These tips will provide 40 L/ac when operated at 8 km/hr and 200 kPa.
   (b) 0.3 mm or larger line strainers or screens. Note that felt filters, smaller nozzle tips or smaller screens will become clogged when using the wettable powder formulation.

5. APPLICATION TIPS: For red turnip beetle, spray an 18-30 m wide band around the field or where beetles are causing damage. Repeat as necessary. ***Mixing:*** The wettable powder mixes easily with water. Mix the required amount of powder with a small quantity of water. Add this pre-mix through the screen while filling the sprayer tank or fill the tank to the required level and then add the pre-mix. Operate the agitator while mixing.
   The spray concentrate forms an emulsion when diluted with water and is suitable for use in all power-operated ground sprayers and aircraft sprayers. To mix, pour the required amount of spray concentrate into full amount of water and then agitate.

6. GRAZING RESTRICTIONS: Do not graze treated areas within 21 days of application.

7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (11). Highly toxic to bees exposed to direct treatment or residues on crops. Poisonous if swallowed, inhaled, or absorbed through the skin.

8. PRECAUTIONS, FIRST AID: KEEP OUT OF REACH OF CHILDREN. Do not get in eyes or on skin. Wear protective clothing, natural rubber gloves, and goggles. Do not breathe dust or spray mist. Wear a pesticide respirator. DO NOT USE on greenhouse food crops or other crops used for food or forage. Use only according to label directions. Application at rates above those shown may result in illegal crop residues. To protect fish and wildlife, do not contaminate streams, lakes, or ponds. Do not apply when crop is in bloom or allow spray to drift towards beehives. DO NOT CONTAMINATE FEED OR FOOD. Keep all unprotected persons out of the operating area or vicinity where there may be danger of drift. Workers who must enter treated fields within 2 days of application should wear protective clothing. Wash hands, arms, and face thoroughly with soap and warm water before eating or smoking. Wash all contaminated clothes with soap and hot water

before reuse. ***Symptoms of poisoning:*** tightness in the chest, sweating, contracted pupils, stomach pains, vomiting and diarrhea.

First Aid: CALL A PHYSICIAN IMMEDIATELY. Have patient lie down and keep quiet. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Repeat until vomit fluid is clear. The patient should be lying down with the head below the foot level and facing down or to the side.

FOR THE PHYSICIAN: Compound inhibits cholinesterase, resulting in stimulation of the central nervous system, the parasympathetic nervous system, and the somatic motor nerves. Do NOT give morphine. Watch for pulmonary edema which may develop in serious cases of poisoning even after 12 hours. At first sign of pulmonary edema, the patient should be placed in an oxygen tent and treated symptomatically. **ANTIDOTE:** Administer atropine sulfate in large therapeutic doses. Repeat as necessary to the point of tolerance. 2-PAM is also antidotal and may be administered in conjunction with atropine

9. STORAGE: Do not store spray concentrate below -4°C. Protect products from heat and open flame. Do not heat.
10. DECONTAMINATION AND DISPOSAL: Do not reuse container. Completely empty the container. Rinse empty drum by filling with water and adding 250 mL household lye/25 L water; punch holes in top and bottom and crush. Bury unused chemical, rinse solution and crushed container at least 50 cm deep in a non-crop, non-graze area away from water supply.

LANNATE, NUDRIN (methomyl)
DuPont

DANGER POISON

1. FORMULATIONS: Solutions - Lannate L (215 g methomyl/L).
   - Nudrin (216 g methomyl/L)
2. HOW IT WORKS: Methomyl is a carbamate insecticide which works by contact and ingestion and has some systemic action. Rapidly degraded in green, growing plants; short-term residual. Rapid knock-down.
3. NUMBER OF APPLICATIONS: As needed, no restriction on number of applications per season.
4. HOW TO APPLY:
   With: Ground equipment (all crops) or aircraft (canola, flax, wheat, oats and barley).
   Rate:

Crop	Insect	L/ac
Canola (8)	Alfalfa looper, bertha armyworm, beet webworm, clover cutworm	0.4-0.5
Corn, sweet (3)	Corn earworm	0.8-1.1
	European corn borer	1.1
Flax (8)	Bertha armyworm, flax bollworm	0.4-0.5
Potato (3)	Aphids, flea beetles, leafhoppers	0.9
Wheat (20), oats (20), barley (20)	Common armyworm	0.5-0.9
	Thrips	0.5

   NOTE:
   (a) Pre-harvest interval (days) given in brackets after crop.
   (b) When a rate range is specified, use the low rate only for very young insects, small plants or light infestations.
   Water Volume: Ground spray - use 20-60 L/ac; Aerial spray - use a minimum of 16 L/ac.
5. APPLICATION TIPS: Apply at the recommended rates in sufficient water to obtain thorough, uniform coverage. Best control is obtained when spray schedules are initiated on young insects. Repeat application as necessary. Early morning or late evening sprays are recommended. ***Sweet corn:*** for earworm, spray whorls as needed and silks at 2-4 day intervals or as needed; for European corn borer consult your district agriculturist - spray at 3-5 day intervals or as needed when insects first appear.
6. TOXICITY: Acute oral LD_{50} rate (mg/kg) = (17). Toxic to bees. May cause blindness if swallowed or inhaled.
7. PRECAUTIONS, FIRST AID:
   Sodium hydroxide causes burns. Do not get in eyes or on clothing. Wear a respirator and protective gear (goggles, boots and gloves) to avoid contact with skin and eyes. Extremely flammable. Use in an adequately ventilated area. Aircraft pilot should not assist in the mixing and loading operation. Apply when bees are not foraging. ***Symptoms of poisoning:*** weakness, blurred vision, headache, nausea, abdominal cramps, discomfort in the chest, constriction of pupils, sweating, slow pulse, or muscle tremors.
   First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). MEDICAL ATTENTION IS NECESSARY IN ALL CASES. **Atropine is an antidote.** Consult physician for an emergency supply of 1/100 grain atropine tablets. If symptoms appear before a physician arrives, immediately swallow 2 atropine tablets (each 1/65 mg); thereafter, every 10-15 minutes, take 1 atropine tablet until the throat becomes dry and the skin becomes dry and flushed. Take additional tablets as necessary to maintain a moderately dry throat and dry, flushed skin until a physician is available.
8. STORAGE: Do not store below 0°C. Above 136°C, product decomposes and may explode if confined.
9. DECONTAMINATION AND DISPOSAL: ***Spill or Leak Procedure:*** Do not get in eyes, on skin or clothing. Keep people away and upwind of spill/leak. If necessary to enter the spill area, wear self-contained breathing apparatus, gloves, boots and protective clothing. Try to remove leaking containers and put them into leak-proof containers. Sweep up spills; apply earth, sand or sweeping compound to spill area and re-sweep to pick up residue. Package spill material in plastic, cardboard or metal containers; bury in a safe place away from water supplies. If product enters crevices and cannot be effectively swept, treat with a sodium hydroxide (Drano) water solution and allow to stand 4 hours. Thereafter, flush well with water; do not flush into any body of water. If product enters sewers or bodies of water, notify appropriate local and federal authorities.

LINDANE (gamma BHC)
Chipman/Uniroyal

1. FORMULATIONS: Dusts (12-75% gamma BHC by weight), Solutions (15.7-21.5%), Suspensions (10-49.9%), Wettable powders (16.6-50%).

2. REGISTERED MIXES: Most commercial formulations of lindane for seed treatment are mixed with 1, 2 or 3 fungicides (any of: benomyl, captan, carbathiin, maneb, TCMTB, thiram). The insecticide diazinon is added to some.

3. HOW IT WORKS: Lindane is an organochlorine insecticide which works by ingestion and contact.

4. HOW TO APPLY:
With: Seed treater or as a drill-box mix.
Rate:

Crop	Insect	Rate
Canola, cereals, corn, sugar beets, (seed treatments)	Flea beetles, wireworms	Varies with formulation; follow label for specific dosage

5. APPLICATION TIPS: Use mineral oil or linseed oil as a sticker (150 mL/25 kg seed) when applying the higher rate of dust as a seed treatment for severe flea beetle infestation by:
(a) mixing oil and seed to coat,
(b) mixing again with dust and,
(c) using planting equipment that can be satisfactorily adjusted to compensate for the increased coating on the seed.

6. GRAZING RESTRICTIONS: Do not use treated seed for feed, food or oil processing. Do not graze or feed livestock on treated areas for 4 weeks after planting.

7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (88-91).

8. PRECAUTIONS, FIRST AID: Read the label before using any product. Wear protective gear to avoid contact with skin or eyes. Do not inhale dust. Work in a well ventilated area. Change clothes daily. If treated seed is to be stored label as ***"POISONOUS TO MAN AND ANIMALS. Do not use as feed. This seed is treated with Lindane for control of insects."***
Symptoms of poisoning: nausea, vomiting, hyperirritability, convulsions, and coma.
First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention immediately.

9. STORAGE: Solution products may be frozen; crystals will dissolve when warmed to 0°C. **NOTE:** Freezing can damage the container. Protect suspensions from low temperatures.

LORSBAN 4E (chlorpyrifos)

Dow

1. FORMULATION: Emulsifiable concentrate - Lorsban 4E (480 g chlorpyrifos/L).
2. HOW IT WORKS: A broad-spectrum, non-systemic insecticide. Works by contact, ingestion and vapour action.
3. NUMBER OF APPLICATIONS: Once per season as (a) a foliage treatment of barley, oats, wheat and canola, (b) as a seedling or soil treatment of potatoes and (c) as a seedling treatment of canola, flax, sugar beet and sunflower. Not more than 9 weekly applications on potato foliage.
4. HOW TO APPLY:
   With: Ground or aerial equipment
   Rate:

Crop	Insect	mL/ac
Seedling potatoes and corn (both 70)	Cutworms	490-970
Seedling canola, flax (both 21), seedling sugar beet (90)	Cutworms	350-490
Seedling sunflower (90)	Cutworms	490
Foliage: barley, oats, wheat (all 60)	Armyworm, cutworms	350-490
	grasshoppers (young)	235
	(all stages)	400
	Wheatmidge	300
Foliage: potato (7)	Potato flea beetle, tarnished plant bug, Colorado potato beetle	400
Foliage: canola (21)	Bertha armyworm, alfalfa looper	300-400
	Diamondback moth (larva)	400
	Common armyworm, grasshoppers	350-400

   NOTE:
   (a) Pre-harvest interval (days) given in brackets after crop. Wait-interval for canola is counted from day of processing.
   (b) Rate range - use lower rate for young insects, light infestations or sparse foliage.
   Water Volume: Seedling canola and flax - 32-80 L/ac by ground, 4-8 L/ac by air; seedling sugar beet and sunflower - 32-80 L/ac; barley, oats and wheat foliage - 20-80 L/ac; potato foliage - 160-325 L/ac; canola foliage - 16 L/ac by ground, 4 L/ac by air; all other applications require 80-160 L/ac.
5. APPLICATION TIPS: ***Cutworms:*** Use the higher rates when the top 1 cm of soil surface is extremely dry or when the infestation is heavy. Early evening applications are best. Apply when damage first appears. Foliage treatments: when spraying crops near maturity, an application system that gives maximum penetration of the crop canopy is necessary to get good insect kill.
6. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (135-163). Toxic to bees.
7. PRECAUTIONS, FIRST AID: Wear protective gear to avoid contact with skin or eyes. Do not inhale vapours or spray mist. Do not apply to blooming crops. ***Symptoms of poisoning by inhalation include:*** stuffy, runny nose, scratchy throat, asthmatic wheezing, sudden bronchospasm, swelling of oral and laryngeal mucous membranes, shock. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting. Get medical attention immediately.

MALATHION, CYTHION (malathion)
Cyanamid

1. **FORMULATIONS:** Emulsifiable concentrates - 500E, 500, 50% (500 g malathion/L). Grain Protectant - Liquid (1 kg malathion/L). Deodorized - Dust (2% malathion).

2. **HOW IT WORKS:** Malathion is a non-systemic, contact, organophosphate insecticide and acaricide of brief to moderate persistence. Generally non-phytotoxic. Not effective below 20°C (does not apply for control of stored grain insects).

3. HOW TO APPLY:

(a) Emulsifiable Concentrates

With: Ground equipment or aircraft equipment.

Rate:

Crop	Insect	L/ac
Alfalfa (7), clover (7),	Alfalfa weevil larvae, aphids grasshoppers, leafhoppers, lygus bugs, spittle bug adults	0.9-1.1
Canola (7), mustard (7)	Flea beetles, grasshoppers	0.4-0.7
	Diamondback moth larvae	0.2-0.3
Flax (7), pastures (0)	Grasshoppers	0.4-0.7
Cereals (7), hay (7)	Grasshoppers	0.7
	English grain aphid	0.8-1.1
Potato (3)	Aphids, Colorado potato beetle, leafhoppers	0.6-0.8
Sugar beet	Flea beetles	0.4
Sweet clover	Sweet clover weevil	0.6-1.0

NOTE:

(a) Pre-harvest or pre-grazing interval (days) in brackets following crop.

(b) Rate ranges: use lower rate for immature insects, light infestations or sparse foliage.

Water Volume: For potato pests, use recommended rate in 400 L/ac finished spray.

(b) Grain Protectants

With: Spray or dust application.

Rate:

Insect	Grain	mL/1000 mL Liquid	g/kg Grain Dust
Flour and grain beetles, grain mites	Barley	12	520
	Corn	10	
	Oats	17	735
	Rye	10	450
	Wheat	10	415
Indian meal moth	Barley, corn, oats, rye, wheat	300 mL/100 m² of grain surface	

NOTE: Stored grain should not be offered for sale until 7 days after treatment.

Water Volume: For Indian meal moth, use the recommended rate in 5-10 L water. For all other pests, use the recommended rate in 10-20 L water.

Incorporation: Scatter proper amount of dust on each load and cut in with shovel before dumping or add grain as it is being augered.

4. APPLICATION TIPS: ***Alfalfa and clover:*** apply when about 75% of foliage shows weevil feeding damage. Do not apply when crop is in bloom. ***Sugar beet:*** apply at 3-5 leaf stage when insects or damage first appears. ***Sweet clover:*** spray field margins of first year clover in late summer or early fall when migration of weevil adults is occurring. ***All crops:*** Apply when day temperature is expected to exceed 20°C. ***Stored Grain:*** to protect from attack by Indian meal moth, apply spray evenly over the surface of clean or uninfested grain and rake to a depth of 15 cm. Apply immediately after grain is loaded into storage. For control of pests in grain on the farm, where special application equipment is not available, any type of low pressure sprayer holding 5 L or more can be used. Spray can be applied to the grain stream as grain is being elevated into storage. First, test sprayer calibration by discharging into a tank of water, then regulate flow of grain to get the proper rate of spray. Keep spray coarse to avoid loss as "drift". ***Before storing new grain:*** thoroughly clean up old grain and debris from bins, elevators, or grain handling equipment. Remove and burn all sweepings. After cleaning the premises, apply a residual malathion spray to walls, floors and machinery in grain elevators or farm storage, using a solution containing 200 mL Grain Protectant/5 L water. Make sure the spray is forced into cracks and crevices. Apply at the rate of 5 L of spray/100 m² of surface area using a coarse wetting spray. Wait until spray has thoroughly dried before storing

grain in treated areas. This same spray should be applied around the outside of bins and elevators to help prevent re-infestation.

5. GRAZING RESTRICTIONS: ***Forages and pasture:*** remove cattle before spraying; cattle may be returned immediately after spraying.

6. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (2,800). Toxic to bees.

7. PRECAUTIONS, FIRST AID: Wear protective gear to avoid contact with skin or eyes - do not inhale vapour, spray mist or dust. Do not apply to plants in bloom. ***Symptoms may include:*** headache, weakness, sweating, giddiness, blurred vision, nausea, abdominal cramps, diarrhea, and discomfort in chest.
First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.

8. DECONTAMINATION: Malathion breaks down rapidly in the presence of water and alkaline materials. Containers and spillages can be readily decontaminated by use of Javex or lye, or washing soaps containing sodium hydroxide. Residues of malathion can be buried in a suitable disposal area. First, place a layer of soda ash or hydrated lime at the bottom of a pit, then pour in the malathion, add another layer of soda ash or lime. Finally, cover with a mixture of Javex and water and top with soil. The amount of soda ash or lime and Javex will be dependent upon the amount of malathion to be decontaminated.

METHOXYCHLOR, MARLATE (methoxychlor)

Numerous Manufacturers

1. FORMULATIONS: Emulsifiable concentrates - (240 g methoxychlor/L)
2. REGISTERED MIXES: Methoxychlor and a fungicide (e.g. captan)/seed treatments.
3. HOW IT WORKS: Methoxychlor is a non-systemic, organochlorine insecticide which works by contact and ingestion. Not for aphids or mites. Short residual.
4. NUMBER OF APPLICATIONS: Repeat as necessary at intervals of 7-10 days (alfalfa and clover with insects other than armyworm, potatoes); 7-14 days (for armyworm on alfalfa, clover, wheat, oats, rye, barley and corn).
5. HOW TO APPLY:
   With: Ground or aircraft equipment.
   Rates:

Crop	Insect	L/ac
Alfalfa, clover	Alfalfa weevil, sweet clover weevil, flea beetles, leafhoppers, grasshoppers	2.0-2.6
Alfalfa, clover, wheat, corn, oats, barley, rye	Armyworm	2.8-4.9
Potato	Blister beetle, Colorado potato beetle, flea beetles, leafhoppers	1.3-4.3

   NOTE:
   (a) Pre-harvest or pre-grazing interval for foliage application is 7 days for crops listed.
   (b) Rate range - use lower rate for immature insects, light infestations or sparse vegetation.
   Water Volume: Aerial application - use 12-40 L/ac. Ground application - use sufficient water for good coverage.
6. APPLICATION TIPS: Apply when insects or damage first appears or, for alfalfa weevil, when 60-75% of alfalfa tips show feeding damage. Methoxychlor is the safest insecticide to use on alfalfa seed crops for alfalfa weevil control during the pollination period. Applications should be made in the late evening.
7. GRAZING RESTRICTIONS: Do not feed treated potatoes or potato refuse to livestock.
8. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (6,000).
9. PRECAUTIONS, FIRST AID: Wear protective gear to avoid contact with skin or eyes. Do not inhale vapours or spray mist. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - do NOT induce vomiting if the product contains petroleum distillate. Read the label for directions. Get medical attention.
10. STORAGE: If product is exposed to prolonged cold, place in warm storage at 10-20°C for several hours; agitate before using.

MONITOR (methamidophos)
Chemagro

1. FORMULATIONS: Solution (480 g methamidophos/L)
2. REGISTERED MIXES: Compatible with most commonly used fungicides.
3. HOW IT WORKS: Methamidophos is a broad spectrum organophosphorus insecticide and acaricide which works by contact and systemic action. Non-phytotoxic when used as directed. Contact effectiveness may persist for 7-21 days.
4. NUMBER OF APPLICATIONS: Two per season on canola. Repeat as necessary on potatoes.
5. HOW TO APPLY:
   With: Ground or aircraft equipment.
   Rate:

Crop	Insect	L/ac
Canola (10)	Bertha armyworm	0.3-0.5
	Grasshoppers	0.5
Potato (14)	Aphids, Colorado potato beetle, potato flea beetle, potato leafhopper	0.7-0.9

   NOTE:
   (a) Pre-harvest interval (days) given in brackets after crop.
   (b) Rate range - use the higher rate for severe infestations, adult insects, or dense foliage.
   Water Volume: Ground application - 80-400 L/ac. Aerial application on canola - use not less than 4 L/ac.
6. APPLICATION TIPS: Apply when insects or damage first appears. Potatoes - apply at 10-14 day intervals or as necessary.
7. TOXICITY: Acute oral LD_{50} rate (mg/kg) = (30). Extremely toxic to wildlife. Highly toxic to bees exposed to direct treatment or residues on crops.
8. PRECAUTIONS, FIRST AID: Do not inhale vapours or spray mist. Wear a protective respirator suitable for protection against organophosphorous insecticides. Wear standard protective clothing (see page 2), rubber gloves, and goggles. Keep unprotected personnel out of mixing and spray area. DO NOT APPLY under conditions involving possible drift to food, forage or other planting that might be damaged or the crops thereof rendered unfit for sale, use or consumption. KEEP OUT OF LAKES, STREAMS AND PONDS. Fish will be killed if their waters are contaminated. Avoid using during pollination period. ***Symptoms of poisoning:*** tightness in the chest, sweating, contracted pupils, stomach pains, vomiting and diarrhea. In case of poisoning get medical attention immediately. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Repeat until vomit fluid is clear. Patient should be lying down with head below the foot level and turned to the side.
9. STORAGE: This product is to be stored and displayed apart from food or feed. Do not store in or around the home. Store in a cool, dry place but not below -10°C. Protect from heat.

PIRIMOR (pirimicarb)
Chipman

1. FORMULATIONS: Wettable Powder - WP (50%)

2. REGISTERED MIXES: Pirimor is compatible with thuricide HPC, Dipel, Sevin.

3. HOW IT WORKS: Pirimicarb is a carbonate insecticide which works by contact, vapour and local systemic action. Pirimicarb is specific to aphids and fits into integrated control programs.

4. HOW TO APPLY:
With: Ground or aircraft equipment.
Rate:

Crop	Insect	g/ac
Peas (6)	Pea aphid	61-111
Potatoes (7)	Green peach aphid Buckthorn aphid	170-220
Corn, sweet (3)	Aphids	220

NOTE:
(a) Pre harvest interval (days) given in brackets after crop.
(b) Rate range - use higher rate when aphid populations are high or when very cool weather is prevailing.
Water Volume: Peas - at least 8 L/ac for aircraft. Potatoes - 200-400 L/ac.

5. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (147).

6. PRECAUTIONS, FIRST AID: Avoid breathing dust or spray mist. Avoid contact with skin and eyes. Wear standard protective clothing (see page 2), gloves, overalls and eye protection. Wash hands and exposed skin before meals and after work. Change contaminated clothing daily. ***Symptoms of poisoning:*** blurred vision and/or breathing difficulties. If symptoms occur, move out of sprayed area and call a doctor.
First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
FOR PHYSICIAN: Pirimor is a moderate, reversible cholinesterase inhibitor. Atropine at 1-4 mg by intramuscular injection is antidotal followed by a further 2 mg every 30 minutes as necessary. P2S and 2-PAM are not effective.

SEVIN (carbaryl)

Union Carbide/Chipman

1. **FORMULATIONS:** Liquid Suspensions - XLR, SL (480 g carbaryl/L). Wettable Powder - 50W (50% carbaryl). Sprayable Powder - 80S, (80% carbaryl). Chipman Flowable (420 g carbaryl/L).
2. **REGISTERED MIXES:** Most formulations are compatible with a wide range of pesticides. Liquid formulations are not compatible with diesel fuel, kerosene, fuel oil or aromatic solvents. All formulations are unstable when mixed with alkaline materials such as Bordeaux mixture, lime-sulphur and casein-lime spreaders.
3. **HOW IT WORKS:** Carbaryl is a carbamate insecticide which works by contact and ingestion. Moderate to rapid in speed of action with short to moderate residual effectiveness (2 days to 4 weeks) depending on crop/pest complex, formulation and climatic conditions.
4. **NUMBER OF APPLICATIONS:** Repeat as necessary.
5. **HOW TO APPLY:**
   With: Ground or aircraft equipment.
   Rates:

Crop	Insect	Formulation	Qty/ac
Canola (seedlings only, up to 4 weeks after emergence)	Flea beetles, grasshoppers	XLR or SL	500 mL
		80S	300 g
Cereals (14): barley, oats, rye, wheat	Grasshoppers	XLR	0.5-1.4 L
		SL	0.5-1.0 L
		50W	450-900 g
		80S	300-600 g
		F	0.6-1.1 L
Forages (0): alfalfa, clover	Blister beetles, leafhoppers	XLR or SL	1.0-1.6 L
		50W	0.9-1.3 kg
		80S	600-700 g
		F	1.1-1.7 L
	Alfalfa weevil larvae	50W	1.3 kg
		80S	910 g
	Alfalfa caterpillar, armyworm, webworms	XLR or SL	1.0-2.1 L
		50W	0.9-1.8 kg
		80S	700-900 g
		F	1.1-2.25 L
	Cutworms (climbing species)	50W	0.9-1.8 kg
		80S	0.6-1.2 kg
	Sweet clover weevil	50W	0.9-1.8 kg
		80S	600-900 g
Corn (1): field, sweet	Grasshoppers	XLR	0.5-1.0 L
		SL	1.0-1.6 L
	Cutworms (climbing species)	XLR	2.1 L
		80S	1.2 kg
		50W	42.5 g/100 m row.
	European corn borer, corn earworm, fall armyworm	XLR or SL	1.0-1.6 L
		50W	0.9-1.3 kg
		80S	500-900 g
		F	1.1-1.6
Potato (7)	Cutworms (climbing)	XLR or SL	100-125 mL/300 m row
		80S	29 g/100 m row
		50W	42.5 g/100 m row
	Colorado potato beetle	XLR or SL	500 mL
		F	0.6 L
	Flea beetles, leafhoppers Colorado potato beetle Potato flea beetles, leafhoppers	XLR	500 mL
		50W	4.45 kg
		80S	300-600 g
		50W	900 g
		F	1.1 L

NOTE:

(a) Pre-harvest or pre-grazing intervals (days) given in brackets after crop.

(b) Rate ranges - use the lower rate on immature insects, light infestations or sparse foliage; use the higher rate for adult insects, severe infestations or dense foliage.

Water Volume: On all crops, use sufficient water to obtain thorough and uniform coverage (usually between 22-180 L/ac of spray depending on equipment, severity of infestation and stage of crop growth). ***Low volume aerial applications:*** hot, dry conditions may cause excessive evaporation of droplets. A higher spray volume per acre may be required under hot, dry conditions and when crop canopies are particularly dense. Dilutions greater than 1:11 (XLR:water) not recommended when wash off resistance is desired. Clean lines and tank after spraying. ***Liquids:*** Use at least 4.0 L/ac of prepared spray in aerial applications and at least 12 L/ac of prepared spray for low volume ground applications. For XLR use as low a water volume as possible, but still achieve good coverage. ***Wettable Powder:*** Use at least 11-14 L/ac and at least 4-14 L/ac of prepared spray for aerial applications. ***Climbing cutworms:*** on corn, use at least 90-120 L/ac with XLR or 80S, or 90-140 L/ac with 50W; on forages and cereals, use at least 225 L/ac with 50W or 80S.

Nozzles: Low volume applications: For wettable powder, use 50-mesh or coarser screens in entire system; nozzles should be cone type, No. 3 or larger. For XLR, use 50-mesh, in-line strainers and 25-mesh, slotted strainers behind the nozzle; nozzle should be of cone type sizes D6-45 or D8-45. For flowables use finer than 50 mesh screen. **NOTE:** (Flat fan nozzles may be used [sizes 8008-8010] but care should be taken as excessive droplet breakup and resulting production of fine droplets may occur. Flat fan nozzles are also prone to plugging under hot, dry conditions).

6. APPLICATION TIPS: Timing and good coverage are essential for effective control. Apply when insects or damage first appears. Prepare only as much spray mixture as is needed on the day of mixing. Do not store spray mixtures overnight. Calibrate spray equipment to deliver the required volume.
   For all carbaryl formulations, agitate, stir or recirculate prior to use. Remove oil, rust, scale, pesticide residues and other foreign matter from mix tanks and entire spray system.
   A dilution of 1:1 (XLR:water) will allow maximum resistance to rainfall or overhead irrigation. Avoid applying carbaryl just before rainfall. Spray droplets must dry on the foilage to have wash-off resistance. Under low humidity, at least 1 hour drying is adequate. Wash-off resistance cannot be expected when XLR is applied to wet foilage which does not dry before rainfall. ***Corn:*** for larvae in whorls and for foliage feeders, treat entire plant. For climbing cutworms, spray in a 25-30 cm band over the row. For insects attacking silks and ears, apply, if necessary, at 2-4 day intervals; start when first silks appear and continue until silks begin to dry. Three or more applications may be required depending on the severity of the infestation. ***Grasshoppers:*** on pasture, rangeland and associated borders, use XLR formulation at 500-900 mL/ac for nymphs or on sparse vegetation, or 0.9-1.4 L/ac for adults or dense vegetation. ***Alfalfa Weevil:*** if pre-treatment damage is extensive, cut and make application to stubble.
7. GRAZING RESTRICTIONS: Remove cattle from area to be sprayed. Cattle may graze immediately after application. Treated forage and feed crops may be fed to dairy animals and animals for slaughter provided sprays are applied as directed.
8. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (540). Toxic to bees.
9. PRECAUTIONS, FIRST AID: Wear protective gear to avoid contact with skin and eyes - do not inhale spray mist. Except for the XLR formulation, Carbaryl should not be applied to crops in bloom. XLR can be applied when bees are not foraging provided the residue on the plants is dry before foraging commmences. ***Symptoms may include:*** salivation, tearing, urination, defication, pinpoint pupils, muscle spasms, general muscular weakness, nausea, prostration, convulsions.
   First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention immediately. IN EMERGENCY, phone collect (24 hours a day) 1-(514)645-5311.
10. STORAGE: Do not store where temperature frequently exceeds 38°C. All formulations will withstand freezing.

SUPRACIDE (methidathion)

Ciba-Geigy

1. FORMULATION: Emulsifiable concentrate (240 g methidathion/L)
2. REGISTERED MIXES: None. Supracide is compatible with many fungicides.
3. HOW IT WORKS: A non-systemic organophosphate insecticide. Works by contact and ingestion.
4. HOW TO APPLY:
   With: Ground or aircraft equipment.
   Rate:

Crop	Insect	L/ac
Alfalfa (10)	Alfalfa weevil, leafhoppers, lygus bugs, pea aphid	0.4-0.9
	Alfalfa blotchleaf minor	0.7-0.9
Canola (30), mustard	Flea beetles	0.3
	Diamondback moth, red turnip beetle	0.4
Potato (14)	Colorado potato beetle, flea beetles, leafhoppers, tarnished plant bug	0.4
Sunflower (50)	Painted lady butterfly, sunflower maggot, sunflower moth	0.9-1.2
	Sunflower beetle	0.4-0.9

   NOTE:
   (a) Pre-harvest interval (days) given in brackets after crop.
   (b) Rate range - use the higher rate for severe infestation, adult insects, or dense foliage.
   Water Volume: Ground equipment - 45 L/ac; aircraft application - 9 L/ac or 4.5-9.0 L/ac for potatoes.
5. APPLICATION TIPS: Apply to alfalfa when insects or damage first appears or when 20-30% of stems have tip damage by alfalfa weevil. Repeat application as necessary or, for potatoes, at 7 day intervals (exception flea beetles and Colorado potato beetles at 10-15 day intervals). Thorough coverage of foliage is essential. Do not apply when rain is imminent.
6. GRAZING RESTRICTIONS: Do not harvest alfalfa for feed or hay or allow livestock to graze within 10 days of application. Do not feed or allow livestock to graze on treated canola, mustard or sunflower.
7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (65). Toxic to bees.
8. PRECAUTIONS, FIRST AID: Do not get in eyes, on skin or clothing. Wear goggles or face shield and rubber gloves when mixing. Do not inhale spray mist. Wear a respirator during prolonged use. Do not re-enter the treated field on day of application. Do not apply to crops in bloom. A minimum 3 day re-entry period for foraging bees is necessary. ***Typical organophosphate poisoning symptoms may include:*** headache, dizziness, blurred vision, weakness, nausea, cramps, diarrhea, discomfort in chest, sweating, salivation, pulmonary edema, cyanosis, uncontrollable muscle twitches, loss of reflexes, convulsions, coma.
   First Aid: **Atropine is antidotal.** IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for eyes. IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
9. STORAGE: Store at temperatures above 0°C. Do not use or store near heat or open flame.

TEMIK (aldicarb)
Union Carbide

1. FORMULATION: Granular - Temik 10G (10% aldicarb)

2. REGISTERED MIXES: Compatible with most fertilizers and pesticides. Do not use with alkaline materials such as lime.

3. HOW IT WORKS: Aldicarb is a soil-applied, systemic, carbamate insecticide. Soil moisture is required to release the active chemical from the granules (corn cob grits) so irrigation or rainfall should follow application. Uptake by roots is rapid; residual activity varies with dosage and pests involved but often lasts more than 6 weeks.

4. NUMBER OF APPLICATIONS: One application per year for field crops.

5. HOW TO APPLY:
With: Ground equipment.
Rate:

Crop	Insect	kg/ac	g/100 m row
Potato	Flea beetles, Colorado potato beetle, leafhoppers	9.0	200
	Aphids	4.5	100
Sugar beet	Sugar beet root maggot	4.5	100

Incorporation: ***Furrow Treatment:*** Apply granules with seed in the planting furrow and cover with soil. ***Band Treatment:*** At planting, apply granules in a 20 cm wide band and work into the soil or cover with soil to a depth of 10 cm. Plant seed pieces in the treated zone. ***Side Dressing:*** At post-emergence, drill granules at a depth of 8-20 cm (usually 2.5-5 cm below the seed pieces) on both sides of the row, 5-10 cm from the row.

6. APPLICATION TIPS: Do not apply to very dry soil unless treatment is followed by irrigation. Calibrate and adjust application equipment to insure proper rate and accurate placement.

7. RESTRICTIONS: Do not harvest potatoes or sugar beets within 90 days of application. Do not harvest sugar beet tops for livestock feed within 120 days of application. Do not use tops from treated beets as food for humans. Do not use plant parts for food or feed. Do not plant food crops in soil treated with this product for at least 1 year after treatment.

8. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (0.6).

9. PRECAUTIONS, FIRST AID: Wear protective, long-sleeved clothing, goggles, pesticide respirator, and rubber gloves when handling. After work, wash entire body with soap and water. Wash contaminated clothing and protective equipment in a strong solution of washing soda and rinse thoroughly before wearing again. Avoid any contact with the product. Deep disc spills at row ends immediately to prevent birds from feeding on exposed granules. Do not mix granules directly with water. Do not use applicators that would grind granules. Do not apply to crops in open bloom. ***Symptoms of poisoning:*** weakness, headache, sweating, nausea, vomiting, diarrhea, tightness in chest, blurred vision, pinpoint pupils, abnormal flow of saliva, abdominal cramps, unconsciousness.
First Aid: CONTACT A PHYSICIAN IMMEDIATELY IN ALL CASES OF SUSPECTED POISONING. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Give water, repeat until vomit fluid is clear. Start artificial respiration if victim stops breathing. Get to a physician or hospital immediately. IN EMERGENCY, telephone collect 24 hours a day 1-(514)645-5311.

10. STORAGE: Do not refrigerate.

11. DECONTAMINATION AND DISPOSAL: ***Spills on Floors:*** If spills occur on floor areas, use a sweeping compound to clean up. Decontaminate the waste with a solution of caustic soda, a strong commercial bleach and detergent. Wash floor with the decontamination solution and rinse well with clean water. Clean up the solution and rinse water with absorbent material such as sawdust, sweeping compound or rags. Dispose of waste and rinsings by burying in a non-crop, non-graze area away from all water supplies. ***Spills on Ground:*** If spills occur on the ground, collect the material and dispose of it as described. Treat the affected area with the decontamination solution and cover with clean soil. ***Decontamination Solution:*** Into 10 L of water, slowly and carefully add in sequence 130 g detergent, followed by 525 g caustic soda (lye) and finally 1.2 L of commercial bleach (sodium hypochlorite). Handle and use the solution with great care. Do NOT add water to dry lye. ***Disposal:*** Dispose of empty containers by delivering them to an approved landfill site for burial.

THIMET (phorate)
Cyanamid

1. **FORMULATION:** Granules - Thimet 15-G (15% phorate).

2. **MARKETING CATEGORY:** Restricted (products to be stored or displayed apart from food or feed).

3. **HOW IT WORKS:** Phorate is a systemic, organophosphorus insecticide with effective initial residual activity against soil insects and other arthropods.

4. **NUMBER OF APPLICATIONS:** One application at planting time.

5. **HOW TO APPLY:**
With: Granular pesticide applicator.
Rate:

Crop	Insect	g/100 m row
Potatoes	Aphids, leafhoppers, leafminers, psyllids, and reduction of potato flea beetle and wireworm damage, Colorado potato beetle (early season control).	140 (sandy or light soils) 215 (silty or heavy soils)

PROTECTIVE EQUIPMENT: Protective clothing, dust mask and rubber gloves while handling product.

6. **APPLICATION TIPS:** Distribute evenly in furrows or band on each side of the row at planting time only. Do not use in muck soils. Do not apply to any area not specified on the label.

7. **TOXICITY:** Acute oral LD_{50} rats (mg/kg) = (29). Acute dermal LD_{50} rabbits (mg/kg) = (226). Highly toxic to fish, birds, and other animals. Poisonous by skin contact, inhalation or swallowing. Repeated inhalation or skin contact may, without symptoms, progressively increase susceptibility to poisoning.

8. **PRECAUTIONS, FIRST AID:** Keep all unprotected persons out of the operating areas. Wear freshly laundered, long-sleeved work clothing daily. Wear dust mask, clean cap and rubber gloves (with cuffs over glove ends). Do NOT handle with bare hands. Pour downwind and allow as little free fall as possible. DO NOT BREATH DUST. Clothing and gloves should be washed with soap and water after each use. Do NOT use the same gloves for other work. Destroy and replace gloves frequently. Do NOT get in eyes, on skin, or clothing. Wash thoroughly before eating, drinking and smoking. Bathe and change outer clothing after each work day. KEEP OUT OF REACH OF CHILDREN AND ANIMALS. ***Symptoms of poisoning:*** weakness, headache, tightness of chest, blurred vision, nonreactive pinpoint pupils, salivation, sweating, nausea, vomiting, diarrhea and abdominal cramps.
First Aid: Call a physician at once in case of suspected poisoning. IN EMERGENCY endangering life or property call collect day or night 613-996-6666. **Atropine is an antidote.** IF INHALED - remove to fresh air. If not breathing give artificial respiration, preferably mouth to mouth. If breathing is difficult, give oxygen. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Remove contaminated clothing and shoes. IF SWALLOWED - induce vomiting (see page 3).
FOR PHYSICIAN: Give atropine intramuscularly or intravenously depending on severity of poisoning, 2-4 mg every 10 minutes until fully atropinized. 20-30 mg, or more may be required during the first 24 hours. Never give opiates or phenothiazine tranquillizers or other depressants. Clear chest by postural drainage. Artificial respiration or oxygen administration may be necessary. Observe patient continously for at least 48 hours. Repeated exposure to cholinesterase inhibitors may, without warning, cause increasing susceptibility to very small doses of any cholinesterase inhibitor. Allow no further exposure to any cholinesterase inhibitor until cholinesterase regeneration has taken place. Pralidoxime chloride (2-PAM: Protopam chloride) may be effective as an adjunct to atropine. Use according to label directions.

9. **STORAGE:** Not for use or storage in or around the home. Must be stored or displayed AWAY from food and feed. Store open bags in labelled sealed drums or heavy plastic bags.

10. **DECONTAMINATION AND DISPOSAL:** ***Procedure for decontamination of surfaces:*** Keep unprotected persons out of the contaminated area. **Protective Equipment:** Hat, overalls, rubber apron, rubber boots and rubber gloves. DO NOT ALLOW product to contact eyes and skin. Launder clothing and clean protective equipment after use. **WARNING:** AVOID smoking, open flames and sparks in the operating area as the decontamination procedure involves use of alcohols.
(a) Cover spilled granules with an absorbent material such as sweeping compound to minimize dust. Sweep up granules and place in a tightly closed labelled container. Store in a secure place. Contact Cyanamid Canada Inc. or federal authorities for details on how to detoxify product. Granules that remain in a broken bag should be transferred to a clearly marked, tightly closed alternate container. Dispose of material in accordance with provincial requirements.
(b) Wash surface with a bleach decontamination solution prepared by mixing 9 L water with 1 L commercial bleach and 0.5 L rubbing alcohol. Rinse with clean water. Clean up the liquid with absorbent material such as sawdust, sweeping compound or other materials. Repeat washing with bleach solution and water until liquid is cleaned up.
(c) Dispose of contaminated absorbent material in accordance with provincial requirements.
(d) Wash disposal equipment with bleach solution and rinse with clean water.
(e) If spill occurs on the ground, collect material and dispose as directed. Treat affected area with the decontamination solution and cover with clean soil. ***Disposal:*** Do not contaminate any body of water, food or feed. Dispose of all empty and broken bags in accordance with provincial requirements but DO NOT BURN. Dispose of empty alternate containers likewise.

THIODAN (endosulfan)
Hoechst

1. FORMULATIONS: Emulsifiable concentrate (400 g endosulfan/L). Wettable powder (50% endosulfan by weight)
2. REGISTERED MIXES: Endosulfan is compatible with most insecticides and fungicides except Bordeaux mixture, hydrated lime, calcium arsenate or zinc sulfate.
3. HOW IT WORKS: Endosulfan is a non-systemic, organochloride insecticide/acaricide with both contact and stomach action.
4. NUMBER OF APPLICATIONS: Repeat as necessary except for corn (sweet and field - not more than twice per season) and sugar beet (not more than once).
5. HOW TO APPLY:
   With: Ground or aircraft equipment.
   Rates:

Crop	Insect	Formulation	Qty/ac
Alfalfa (30), clover (30)	Spittle bugs	EC	0.3 L
Alfalfa seed	Aphids	EC	0.6 L
	Lygus bugs		1.8-2.2 L
Corn (50)	Corn leaf aphid	EC or	1.1 L
		WP	0.9 kg
	Corn earworm	EC or	1.1-1.7 L
		WP	0.9-1.3 kg
Potato (0)	Aphids, Colorado potato beetle, flea beetles, leafhoppers, tuber flea beetles	EC or WP	0.6 L 0.4 kg
Sugar beets (45)	Green peach aphid	EC	0.6 L
	Beet webworm	EC	1.1 L

   NOTE:
   (a) Pre-harvest or pre-grazing intervals (days) given in brackets after crop.
   (b) Rate range - use the lower rate for young insects (larvae), light infestations or sparse foliage.
   Water Volume: Thorough wetting of all plant parts is essential for good results.
6. APPLICATION TIPS: Keep agitator running during filling and spraying. ***Mixing WP:*** fill spray tank nearly full and either pour recommended amount on water surface or pre-mix powder in a bucket 1/2 filled with water then pour mix through screen into nearly filled spray tank. Finish filling tank. Spray upper and lower leaf surfaces.
7. GRAZING RESTRICTIONS: Do not feed treated crop refuse (vines, tops, stocks or threshings) or sugar beet foliage to livestock. Sugar beet roots may be fed. Do not ensile treated corn. Do not graze treated green crops except for alfalfa and clover which should not be foraged within 30 days of application. ***Succeeding crops:*** Do not apply to crops which are to be followed by a root crop other than carrots, potatoes, sweet potatoes or sugar beets.
8. TOXICITY: Acute oral LD_{50} rats (mg/kg) = (80-110). Toxic to bees.
9. PRECAUTIONS, FIRST AID: Wear goggles, respirator, coveralls, and synthetic rubber gloves when mixing or loading or when spray mist cannot be avoided. Apply during late evening. Change clothing daily and wash before reuse. ***Symptoms of poisoning:*** nausea, headache, general feeling of being unwell, followed by generalized convulsion.
   First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for eyes immediately. IF WETTABLE POWDER IS SWALLOWED - induce vomiting (see page 3). Repeat until vomit is clear. Get immediate medical attention. IF EMULSIFIABLE CONCENTRATE IS SWALLOWED - do NOT induce vomiting and avoid breathing vomitus into the lungs should vomiting occur. Get immediate medical attention.
10. STORAGE: Do not store E.C. below -7°C.
11. DECONTAMINATION AND DISPOSAL: For spilled powder, spread with sawdust or dirt to prevent scattering. Apply sodium carbonate, caustic soda or hydrated lime on contaminated area. After 1 hour collect with a shovel or a broom and wash paved areas with water. For spilled liquid, decontaminate with any of above alkaline chemicals and allow to stand for 1 hour. Apply sawdust, talc, or sand to absorb all liquid. Decontaminate tools with hydrated lime. Bury unusable or clean-up product 50 cm deep in an isolated area away from any water supply. Powder removed from the site without decontamination must be decontaminated while being buried by alternating layers of caustic soda or lime with endosulfan powder. When burying with clean-up absorbents from liquid spills, apply a layer of soda, caustic or lime on the top before filling the hole.

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CHEMICAL CONTROL OF PLANT DISEASES IN ALBERTA

Introduction

Plants, like other living organisms, are attacked by many diseases that are caused by fungi, bacteria, viruses, mycoplasmas and nematodes. The management of plant diseases is based on 4 general parameters that include:

a) **Exclusion** or quarantine, i.e. prevention of a disease organism or diseased plant material from entering a country or disease-free area where the disease could become established;

b) **Protection** whereby proper sanitation practices, chemical controls, adequate soil nutrient levels and good soil drainage may be used to protect plants from disease organisms;

c) **Eradication** involving the use of crop rotations or the application of eradicant chemicals such as fungicides; and

d) **Plant breeding** whereby crop plants are selected for partial or complete resistance to a specific disease or range of infectious diseases.

In Alberta, fungal diseases of some field crops may be subject to direct chemical control by fungicides. Control of most other diseases rely on alternate methods. The major use of fungicides in these crops at present is in the treatment of seeds (cereal, forage, oilseed) and potato seed pieces. Except for canola and field beans, foliar fungicides are not generally registered, available or economically feasible at the present time. For convenience, dual purpose treatments with the insecticide Lindane, used in seed-treatment formulations, have been included in this chapter on fungicides.

The principles and procedures involving the use of plant disease control chemicals follow the guidelines outlined for chemical weed control in the first chapter of this manual.

AGROX (mancozeb)

Chipman

1. FORMULATION: Dust - Agrox Potato Seed Piece Dust (mancozeb 18%).
2. HOW IT WORKS: Mancozeb is a protective, seed-treatment fungicide that controls fusarium decay. A contact fungicide.
3. NUMBER OF APPLICATIONS: Once, at time of planting.
4. HOW TO APPLY:
   With: Potato seed duster
   Rate:

Crop	Disease	g/100 kg seed
Potato	fusarium decay	500

5. TOXICITY: Acute oral LD_{50} rats (mg/kg) = mancozeb (12,000). Prolonged exposure may cause eye, nose, throat and skin irritation.
6. PRECAUTIONS, FIRST AID: When treating or handling treated seed, work in a well ventilated area, and wear a suitable dust mask, goggles and gloves. Treated seed should be labelled "***POISONOUS TO MAN AND ANIMALS. This seed has been treated with mancozeb for the control of fusarium decay. Do not use for food or feed purposes.***" Avoid contact with skin, eyes and clothing. Wash thoroughly after handling and before eating, drinking and smoking.
   First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Get medical attention.
7. DECONTAMINATION AND DISPOSAL: Dispose of empty containers by burning or burying with municipal waste according to municipal regulations.

BENLATE (benomyl)

Dupont

1. FORMULATIONS: 50% Wettable Powder
2. REGISTERED MIXES: With fungicides, captan and thiram. Dual purpose formulations with insecticide, lindane. Do not mix with alkaline pesticides such as basic copper sulphate, Bordeaux mixture or lime sulphur.
3. HOW IT WORKS: Benomyl is a protective systemic fungicide.
4. NUMBER OF APPLICATIONS: One per season.
5. HOW TO APPLY:
   With: Ground or aircraft equipment.
   Rate:

Crop	Disease	g/ac
Beans, (dry, white, snap, common) (14)	*Sclerotinia* (white mould), *Botrytis* (gray mould)	710-910
Canola	*Sclerotinia* (stem rot)	400-600

   NOTE:
   (a) Pre-harvest interval (days) given in brackets after crop.
   (b) Rate range - use the high rate under severe disease conditions.
   Water Volume: Beans - 100 L water/500 g product. Canola - minimum 16 L water/ac (air); 40 L/ac (ground).
6. APPLICATION TIPS: Beans - apply between 50 and 100% bloom; thorough coverage. Canola - apply between 20 and 30% bloom; ensure thorough coverage. Continuous agitation is required to keep the material in suspension. Do not apply when rain is imminent; do not irrigate within 6 hours of application.
7. GRAZING RESTRICTIONS: Do not graze or feed treated bean hay to livestock.
8. TOXICITY: Acute oral LD_{50} rats (mg/kg) is greater than (10,000). May irritate eyes, nose, throat and skin. Toxic to fish.
9. PRECAUTIONS, FIRST AID: Do not apply when weather conditions favor drift from treated areas. KEEP OUT OF REACH OF CHILDREN. Avoid breathing dust or spray mist. Avoid contact with skin, eyes, and clothing. Keep away from fire or sparks. ***First Aid:*** IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for the eyes.
10. STORAGE: Never allow product to become wet during storage as reduced fungicidal effectiveness may result. Keep container closed when not in use.
11. DECONTAMINATION AND DISPOSAL: Do not contaminate water sources, lakes, streams or ponds by cleaning of equipment or disposal of wastes. Do not reuse container; burn when empty.

CARBATHIIN
Uniroyal

1. FORMULATIONS: Vitavax Seed Treatment. Solutions - 230 g/L
2. REGISTERED MIXES:
   With fungicides
   Vitavax powder (carbathiin 26:7 : thiram 38.8)
   Pro-gro (carbathiin 30 : thiram 50)
   Dual purpose formulations (with insecticide)
   Vitavax rs flowable (carbathiin 45 g/L : thiram 90 g/L : lindane 680 g/L)
   Vitavax rs powder (carbathiin 3.3 : thiram 6.7 : lindane 50.0)
   Vitavax Dual powder (carbathiin 20.0 : thiram 28.9 : lindane 18.7)
   Vitavax Dual solution (carbathiin 180 g/L : lindane 165 g/L)
3. HOW IT WORKS: Carbathiin a systemic fungicide, penetrates the seed coat to control disease.
4. NUMBER OF APPLICATIONS: Seed treatment - one.
5. HOW TO APPLY:
   With: On-farm treatment - through the auger with special equipment or with an inexpensive pump or dripolator device; or at seed cleaning plant.
   Rate:

Crop	Disease	mL/25 kg seed 230 g/L Solution
Barley	Smuts (covered, false loose, true)	60-75*
Flax	Seedling blight, damping-off, seed decay	100
Oats	Smuts (loose, covered)	60
Rye	Stem smut	60
Wheat	Smuts (true loose, stinking bunt)	60-75*

   ***NOTE:**
   For wheat and barley varieties highly susceptible to true loose smut and for high levels of smut or bunt on seed, the 75 mL rate will give increased disease control. Vitavax Single solution will generally increase emergence and plant stands by reducing seed-borne seed rots and seedling blights. This beneficial effect will allow treated seed to give increased yields for crops growing under stress conditions such as disease, cool weather and drought.
6. GRAZING RESTRICTIONS: Treated seed not to be used as feed. Do not graze or feed livestock on treated areas for 4 weeks after planting.
7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = carbathiin (3,280).
8. PRECAUTIONS, FIRST AID: Read the label before using any product. Work in a well ventilated area. When treating seed, augering or handling treated seed, wear a dust mask, goggles and gloves. Avoid breathing vapours. Treated seed is easily recognized by its prominent red color. KEEP OUT OF REACH OF CHILDREN. Do not get in eyes or on skin.
   First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - Do NOT induce vomiting. Get medical attention immediately.
9. STORAGE: Store above 0°C. Do not store in or around the home.
10. DECONTAMINATION AND DISPOSAL: Do not contaminate lakes, ponds or streams. Puncture and crush empty container, bury 50 cm deep away from any source of water, or take to designated disposal area.

CARBATHIIN : THIRAM
Uniroyal

1. FORMULATIONS: Dust - Vitavax Powder (carbathiin 26.7% : thiram 38.6%).

2. REGISTERED MIXES:
   With the insecticide - lindane (% carbathiin : % thiram : % lindane)
   Vitavax Dual Powder (20.0 : 28.9 : 18.7)
   Vitavax rs Flowable (45 g/L, 90 g/L, 680 g/L)
   Vitavax rs Powder (3.3 : 6.7 : 50.0).

3. HOW IT WORKS: Thiram is a fungicide which controls diseases carried on the seed. Carbathiin is a systemic fungicide which penetrates the seed coat to control diseases inside the seed and seedling.

4. NUMBER OF APPLICATIONS: Seed treatment - one.

5. HOW TO APPLY: Dust - Do NOT mix with bare hands. When starting with an empty drill or planter box, separately treat enough seed to cover the bottom of the box.
   Fill the drill or planter box to 1/2 capacity and sprinkle 1/2 the required amount of powder over the seed. Mix thoroughly with a paddle until the seed is uniformly covered. Seed should all be pink. Then add enough seed to fill the box, cover with the remaining powder and repeat mixing procedure. For large drill or planter boxes, it may be necessary to divide the seed into several portions. Clean planter plates periodically to prevent excessive build-up of treatment chemicals.
   Rate:

Crop	Disease	g powder/25 kg seed
Barley	Smuts (false loose, true loose, covered)	50
Flax	Seedling blight, damping-off, seed decay	60
Oats	Smuts (loose, covered)	70
Rye	Damping-off, seed decay, stem smut	45
Wheat	Smuts (loose, stinking), bunt	55

6. GRAZING RESTRICTIONS: Do not use treated seed for feed, food or oil processing. Do not graze or feed livestock on treated areas for 4 weeks after planting.

7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = carbathiin : thiram (1,600).

8. PRECAUTIONS, FIRST AID: Read the label before using any product. Work in well ventilated area and wear a dust mask, goggles and gloves. KEEP OUT OF REACH OF CHILDREN. ***Symptoms of poisoning:*** skin contact may result in irritation and dermatitis. Consumption of alcohol within 24 hours of working with thiram may cause flushing, sweating, headache and nausea.
   First aid: IF IN EYES - flush immediately with running water. Seek medical attention. IF ON SKIN - wash with warm water and pumice soap to remove dye. IF SWALLOWED - induce vomiting (see page 3). Keep patient quiet. Seek medical attention immediately.

9. STORAGE: Do not store product in or around the home or near food or feed. Store powder in a dry area. Do not store suspension in direct sunlight or at temperatures above 35°C. Suspension will not freeze even in normal winter temperatures. Do not store seed treated with powder.

10. DECONTAMINATION AND DISPOSAL: Do not contaminate any water supply, food or feed.

DUAL PURPOSE FORMULATIONS
BENOMYL : CAPTAN : LINDANE
Chipman

1. FORMULATIONS: Dust - Gammasan + (6% : 10% : 50%). Suspension - Gammasan F (2.7% : 4.5% : 22.8%)

2. HOW IT WORKS: Benomyl systemic fungicide protects against blackleg. Captan fungicide protects young plants against rots and damping-off. Lindane organochlorine insecticide which acts by ingestion, contact and, to a lesser extent, by fumigant action against many soil-dwelling insects.

3. HOW TO APPLY: ***Pre-seeding Treatment:*** preferred method of application. Treat seed in an end-over-end drum-type seed treater or a cement mixer. ***Drill Box Treatment:*** (follow directions carefully - misapplication may result in drill plugging). When starting with an empty planter box, treat enough seed in a separate container to cover bottom of planter box. Mix powder and seed thoroughly until seed is a uniform color by either of the following methods.
Alternate Mixing Methods:
(a) Place and level 1/2 of the seed in drill or planter box and sprinkle uniformly over surface, 1/2 the powder required for the full planter box. Mix thoroughly with a paddle, then fill the box with seed and sprinkle the remaining 1/2 of the powder over the seed and mix again until seed is a uniform color. Do NOT mix with bare hands.
(b) Dribble 775 g of powder into each 25 kg of seed as it is poured into the drill box. Thoroughly mix with a lath or paddle when the drill box is 1/2 full and again when full until seed is a uniform color.
Rate:

Crop	Disease and Insect	Qty/25 kg seed
Canola	Blackleg, seedling blight, flea beetles	750-1550 g 1250 mL

NOTE:
(i) Use the higher rate in areas of heavy flea beetle infestation (generally only produced by successive cropping of flea beetle-susceptible crops on the same or immediately adjacent areas).
(ii) Provides flea beetle protection during germination and early emergence only.
(iii) For high rate, use 150 mL mineral oil or linseed oil as a sticker per 25 kg seed. Churn or mix the seed and oil then add powder and mix again. High rate should be used only with planting equipment that can be adjusted to compensate for the increased coating on the seed.

4. TOXICITY: Acute oral LD_{50} rats (mg/kg) = benomyl (710,000), captan (9,000), lindane (88-125). Lindane is toxic to fish, birds, and other animals. Poisonous if swallowed, inhaled or absorbed through the skin.

5. PRECAUTIONS, FIRST AID: Oil-dressed seed should be sown within 1 week of treating to avoid shedding of treatment. Wash thoroughly after handling or using and before eating or smoking. Consumption of alcohol 24 hours before or after working with thiram may cause sweating, flushing and nausea. KEEP OUT OF REACH OF CHILDREN. ***Symptoms of poisoning:*** Lindane - nausea, vomiting, hyperirritability, convulsions, coma. Skin contact with fungicides may result in irritation and dermatitis.
First aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Give epsom salts as a laxative. Avoid mineral oils and castor oil. Get medical attention.

6. STORAGE: Do not store in the home or near food or feed. NEVER allow product to become wet during storage (this may lead to chemical changes which will reduce the effectiveness of the benomyl fungicide). Keep container closed when not in use. Dry treated seed may be stored for several months.

7. DECONTAMINATION AND DISPOSAL: Wash contaminated clothing before re-use. Do not contaminate bodies of water, food or feed. Bury empty containers.

DUAL PURPOSE FORMULATIONS
BENOMYL : THIRAM : LINDANE
Federated Co-operatives
May and Baker

1. FORMULATIONS: Dusts - Benolin R (6% : 10% : 50%). - Thiralin Plus (6% : 10% : 75%)
2. HOW IT WORKS: Benomyl is a systemic fungicide that protects against blackleg. Thiram fungicide protects against seed-borne diseases. Lindane, an organochlorine insecticide that acts by ingestion, contact and, to a lesser extent, by fumigant action against many soil-dwelling insects.
3. HOW TO APPLY: Seed to be treated with Benolin R may be treated first with canola or vegetable oil (135 mL/100 kg seed) to improve contact between seed and product. Thiralin Plus has an added adhesive. Clean planter plates periodically to prevent excessive build-up of chemicals. Do NOT mix with bare hands. Under certain circumstances, for example, if excessive oil is added, the seed may bridge in the seed drill. Check the seed drill calibration before and during seeding operation.

   Alternative Mixing Methods

   (a) When starting with an empty planter box, first cover the planter box bottom with treated seed (mixed in a separate container) to ensure that first seeds sown are adequately treated. Then fill 1/2 the drill or planter box and sprinkle the required amount of powder over the seed. Mix with a paddle until the seed is a uniform color. Add enough seed to fill the box, cover with the required amount of powder and mix again. For large boxes, it may be necessary to divide the seed into several portions.

   (b) Use a commercial drum or auger, dust seed-treater or a cement mixer.

   Rate:

Crop	Disease and Insect	Formulation	g/25 kg seed
Canola	Blackleg, damping-off, seedling decay, seedling blight, flea beetles	Thiralin Plus	750
		Benolin R	800

4. GRAZING AND CROPPING RESTRICTIONS: Do not use on soil in which edible root crops (except rutabagas and turnips) are to be planted in the same or following season.
5. TOXICITY: Acute oral LD_{50} rats (mg/kg) = benomyl (710,000), thiram (375), lindane (88-125), Thiralin-Plus (40-200). Lindane is toxic to fish, birds, and other animals. Poisonous if swallowed, inhaled or absorbed through the skin.
6. PRECAUTIONS, FIRST AID: Oil-dressed seed should be sown within 1 week of treating to avoid shedding of treatment. Wash thoroughly after handling or using and before eating or smoking. Consumption of alcohol 24 hours before or after working with thiram may cause sweating, flushing and nausea. KEEP OUT OF REACH OF CHILDREN. ***Symptoms of poisoning:*** Lindane - nausea, vomiting, hyperirritability, convulsions, coma. Skin contact with fungicides may result in irritation and dermatitis.

   First aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Give epsom salts as a laxative. Avoid mineral oils and castor oil. Get medial attention.
7. STORAGE: Do not store in the home or near food or feed. NEVER allow product to become wet during storage (this may lead to chemical changes which will reduce effectiveness of the benomyl fungicide). Keep container closed when not in use. Dry, treated seed may be stored for several months.
8. DECONTAMINATION AND DISPOSAL: Wash contaminated clothing before re-use. Do not contaminate bodies of water, food or feed. Bury empty containers.

DUAL PURPOSE FORMULATIONS
CARBATHIIN : THIRAM : LINDANE
Uniroyal

1. FORMULATIONS: (carbathiin : thiram : lindane)
   Suspension - Vitavax rs Flowable (45 g/L, 90 g/L, 680 g/L)
   Dusts - (1) Vitavax rs Powder (3.3% : 6.7% : 50.0%)
   - (2) Vitavax Dual Powder (20.0% : 28.9% : 18.7%)
   Solution - Vitavax Dual Solution (carbathiin 180 g/L : lindane 165 g/L).

2. HOW IT WORKS: Lindane is an organochlorine insecticide which acts by ingestion, contact and, to a lesser extent, by fumigant action against many soil-dwelling and phytophagous insects. Thiram is a fungicide which controls seed-borne diseases. Carbathiin is a systemic fungicide which penetrates the seed coat to control diseases of the seed and seedling.

3. NUMBER OF APPLICATIONS: Seed treatment - once at time of planting.

4. HOW TO APPLY: ***Flowable*** can be applied either in a continuous treating operation with S-Series Treaters or OFT Treaters (available from Uniroyal Chemical) or with batch treaters or cement mixers.
   Fill drill box to 1/2 capacity and sprinkle required amount of powder over seed. Mix with a paddle until seed is an uniform color. Add seed to fill the box, cover with remaining powder and repeat. For large drill boxes, divide the seed into several portions. Clean planter plates periodically to prevent excessive build-up of chemicals.
   Solution can be applied on the farm using an auger with a pump or dripolator device or custom application is available at seed cleaning plants.
   With: Seed-dressing equipment.
   Rate:

Crop	Disease and Insect	g powder	mL/25 kg seed
Barley	Smuts (covered, false loose, true loose), wireworms	70(2)	75-90* (solution)
Canola, Mustard	Seedling blight, damping-off, seed decay, blackleg, flea beetles	750(1)	562 (suspension)
Flax	Seedling blight, damping-off, seed decay	70(2)	
Oats	Smuts (covered, loose), wireworms	95(2)	75 (solution)
Rye	Stem smut, damping-off, seed decay, wireworms	60(2)	
Wheat	Smuts (loose, stinking), bunt, wireworms	65(2)	75-90* (solution)

   *NOTE:
   For wheat and barley varieties highly susceptible to true loose smut and for high levels of smut or bunt on seed, the 90 mL rate will give increased disease control. Vitavax Dual solution will generally increase emergence and plant stands by reducing seed-borne seed rots and seedling blights. This beneficial effect will allow treated seed to give increased yields for crops growing under stress conditions such as disease, cool weather and drought.

5. GRAZING RESTRICTIONS: Do not use treated seed for feed, food or oil processing. Do not graze or feed livestock on treated areas for 4 weeks after planting.

6. TOXICITY: Acute oral LD_{50} rats (mg/kg) = Vitavax rs (302), Vitavax Dual Solution (1,740), carbathiin (3,820), thiram (375), lindane (88-125).

7. PRECAUTIONS, FIRST AID: Read the label before using any product. Work in a well ventilated area and wear a dust mask, goggles and gloves. Consumption of alcohol 24 hours before or after working with thiram may cause sweating, flushing, headache and nausea. KEEP OUT OF REACH OF CHILDREN. ***Symptoms of poisoning:*** With lindane - nausea, vomiting, hyperirritability, convulsions, coma. Skin contact with fungicides may result in irritation and dermatitis.
   First aid: IF IN EYES - flush immediately with running water. Seek medical attention. IF ON SKIN - wash with warm water and soap. IF SWALLOWED - induce vomiting (see page 3). Keep patient quiet. Seek medical attention immediately.

8. STORAGE: Do not store in or around the home and store above 0°C. Seed treated with flowable should be tested for germination before planting if stored for more than 6 months. Do not store in areas where temperatures exceed 25°C. Store powder in dry area. Do not store seed treated with powder.

9. DECONTAMINATION AND DISPOSAL: Do not contaminate any water supply, food or feed. Leftover seed treated with powder should be double sown around the headland, or buried away from water sources.

DUAL PURPOSE FORMULATIONS
IPRODIONE : LINDANE
May and Baker

1. FORMULATIONS: Suspension - Rovral ST Flowable (iprodione 16.7%: lindane 50%).
2. HOW IT WORKS: Lindane, an organochlorine insecticide that works by ingestion, contact and to a lesser extent, by fumigant action against soil-dwelling insects. Iprodione fungicide protects against seed-borne blackleg.
3. NUMBER OF APPLICATIONS: Seed treatment - one.
4. HOW TO APPLY:
   With: On-farm treatment - through the auger with special equipment or with an inexpensive pump or dripolator device; or at seed cleaning plant.
   Rate:

Crop	Disease and Insect	mL/25 kg seed
Canola	Blackleg, flea beetles	750 (suspension)

5. TOXICITY: Acute oral LD_{50} rats (mg/kg) = 200-400.
6. PRECAUTIONS, FIRST AID: Treat only the amount of seed required to avoid storing treated seed. ***Symptoms of poisoning:*** Lindane - may include nausea, vomiting, hyperirritability, convulsions, coma and other symptoms typical of organochlorine insecticide poisoning. Skin contact with fungicides may produce irritation or dermatitis. ***First Aid:*** IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Give epsom salts as a laxative. Avoid mineral oils and castor oil. Get medical attention. FOR PHYSICIAN: Lindane is an organochlorine insecticide. Barbiturates may be given to control convulsions. Oxygen may be indicated. Keep patient quiet. Avoid use of morphine and adrenaline.
7. STORAGE: Do not store in the home, or near food or feed. Protect from frost (freezing).
8. DECONTAMINATION AND DISPOSAL: Do not contaminate any water supply, food or feed.

DUAL PURPOSE FORMULATIONS
MANEB : LINDANE
Federated Co-operatives

1. FORMULATIONS: Dusts - Co-op DP, Mergamma N-M, Pool N-M Dual and Trinox (37.5% : 18.75%)
   Suspension - Mergamma F.L. - (260 g/L maneb : 130 g/L lindane)
2. HOW IT WORKS: Maneb is a protective, seed-treatment fungicide. Lindane is an organochlorine insecticide that works by ingestion, contact and, to a lesser extent, by fumigant action against many soil-dwelling insects.
3. HOW TO APPLY: Place and level 1/2 of seed in drill box and sprinkle 1/2 of required amount of product uniformly over seed. Mix thoroughly with a paddle. Fill box with seed and sprinkle on remaining powder, mix again until all streaking has disappeared and coloring of seed is uniform.
   Alternate Mixing Methods:
   (a) Dribble the required amount of product into the seed as it is poured into the drill box. Thoroughly mix with a paddle when drill box is 1/2 full and again when full until colouring of seed is uniform.
   (b) Apply through a mechanical dispenser or proportioner that attaches to the auger that conveys seed into the drill box.
   (c) Apply with any standard dry seed-treatment application equipment.
   Rate:

Crop	Disease and Insect	g/25 kg seed	mL/25 kg seed
Barley	Smuts (covered, false loose), seedling blight, root rot, wireworms	65 (powder)	100 mL (suspension)
Oats	Smuts, seedling blight, root rot, wireworms	92 (powder)	138 mL
Rye	Bunt, seedling blight, root rot, wireworms	56 (powder)	84 mL
Wheat	Bunt, stinking smut, seedling blight, root rot, wireworms	52 (powder)	78 mL (suspension)

4. TOXICITY: Acute oral LD_{50} rats (mg/kg) = maneb (6,750), lindane (88-91).
5. PRECAUTIONS, FIRST AID: Treat only the amount of seed required to avoid storing treated seed. KEEP OUT OF REACH OF CHILDREN. ***Symptoms of poisoning:*** Lindane - may include nausea, vomiting, hyperirritability, convulsions, coma, and other symptoms typical of organochlorine insecticide poisoning. Skin contact with maneb may produce irritation or dermatitis. ***First Aid:*** IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Give epsom salts as a laxative. Avoid mineral oils and castor oil. Get medical attention.
   FOR PHYSICIAN: Lindane is an organochlorine insecticide. Barbiturates may be given to control convulsions. Oxygen may be indicated. Keep patient quiet. Avoid use of morphine and adrenaline.
6. STORAGE: Do not store in or around the home, or near food or feed. NEVER allow product to become wet during storage. This may lead to chemical changes which will reduce the effectiveness of fungicide. Keep container closed when not in use. Do not store treated seed more than 1 year.
7. DECONTAMINATION AND DISPOSAL: Do not contaminate any water supply, food or feed.

FORMALDEHYDE (formalin)

Later's Chemicals

WARNING POISON

1. FORMULATION: Solution - 37% formaldehyde (formalin)
2. HOW IT WORKS: Formaldehyde is a bactericide and fungicide, used as a soil fumigant and seed treatment, although the latter use is limited by phytotoxicity. (1 mL solution = 1.08 g)
3. NUMBER OF APPLICATIONS: One.
4. HOW TO APPLY:
   With: Small sprayers or sprinklers.
   Rate:

Crop	Disease	g Solution/25 kg grain
Barley	Covered smut	40 (37 mL)
Oats	Smuts (covered, loose)	40 (37 mL)
Wheat	Bunt, covered smut	40 (37 mL)
Potato tubers	Common scab, black scurf, (rhizoctonia)	50 mL solution (cold) OR 100 mL solution (hot)

   Water Volume: ***Potato tubers:*** cold treatment - use 50 mL/10 L water to soak uncut tubers for 2 hours; hot treatment - use 100 mL/10 L 49-52°C water to soak uncut tubers for 3-4 minutes, then cover for 1 hour. Allow tubers to dry before cutting and planting. ***Grain:*** use 325 g solution/100 L water.
5. APPLICATION TIPS: Grain - pile grain on a clean floor, sprinkle well with solution and shovel over until all grains are thoroughly wet. Cover for 4 hours (or overnight) with clean sacks or blankets moistened with solution. Sow as soon as possible, preferably while still damp. If smut balls are present, immerse grain in the solution for 5 minutes. Stir. Skim off smut balls. Drain thoroughly and cover as above.
6. TOXICITY: Acute oral LD_{50} rats (mg/kg) = formaldehyde (800). May cause irritation of skin, eyes, nose, and throat.
7. PRECAUTIONS, FIRST AID: Use with good ventilation. A gas mask should be worn to prevent inhaling the gas fumes, and gloves to prevent skin irritation. Leave the room or building as soon as possible. Avoid prolonged or repeated contact and breathing of vapor. Keep away from heat, fire and sparks. ***Symptoms of poisoning:*** Skin contact may produce irritation and dermatitis. Ingestion may cause severe abdominal pain, nausea, and vomiting, sometimes followed by stupor. Exposure to vapours may cause burning and stinging of eyes and headache.
   First Aid: IF INHALED - remove patient to fresh air; have him lie down and keep quiet and warm. Give patient egg white and milk; obtain medical attention. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - induce vomiting (see page 3). Repeat until vomit fluid is clear. Then give a gruel of flour and water. Rush patient to nearest hospital taking the labelled container with you.
8. STORAGE: Do not freeze. Minimum storage temperature 15°C. Store in a dry, ventilated place, away from food and feed.
9. DECONTAMINATION AND DISPOSAL: Do not contaminate any body of water, food or feed. Puncture empty container and bury at least 50 cm deep and away from water supply.

MANZATE-D, DITHANE M-22 (maneb)
Federated Co-operatives

1. FORMULATIONS: ***Drill Box Seed Treatments:*** Agrox N-M Wettable Powder, Co-op N-M Dust, Pool N-M Dust (50% maneb). ***Foliar Spray:*** Maneb 80-W Wettable Powder (80% maneb). Agrox - Suspension (300 g/L)

2. REGISTERED MIXES: With lindane as dual purpose formulations. Compatible with most insecticides and fungicides but not with Bordeaux mixture or lime.

3. HOW IT WORKS: Maneb is a fungicide, effective against many seedling and foliar diseases.

4. NUMBER OF APPLICATIONS: One for seed treatment. Repeat every 7-10 days for treatment of early and late blight on potatoes; shorten interval to 5-7 days when weather favours disease.

5. HOW TO APPLY: **Protective Equipment:** Wear a dust mask, goggles, long-sleeved shirt, rubber or PVC gloves and rubber or PVC apron when handling product. Ventilate indoor working area.
Alternate Mixing Methods
(a) Place and level 1/2 of the seed in drill box and sprinkle 1/2 of the required amount of product uniformly over seed. Mix thoroughly with a paddle. Fill box with seed and sprinkle remaining powder and mix again until all streaking has disappeared and coloring of seed is uniform.
(b) Dribble the required amount of product into seed as it is poured into drill box. Thoroughly mix with a paddle when drill box is 1/2 full and again when full until coloring of seed is uniform.
(c) Apply through a mechanical dispenser or proportioner that attaches to the auger that conveys seed into the drill box.
(d) Apply with any standard dry seed-treatment application equipment.
Rate:

Crop	Disease	g/25 kg seed	mL/25 kg seed
Barley	Smuts (covered, false loose)	50-66	45 (suspension)
Flax	Seedling blight, damping-off	112	- (not registered)
Oats	Smuts	69-92	115 (suspension)
Rye	Bunt	28-43	45 (suspension)
Wheat	Bunt or stinking smut	26-40	45 (suspension)

Potatoes - early blight - start spraying when plants are 15 cm high.

Crop	Disease	g/ac
Potato (1)*	Early blight, late blight	911
Sugar beet (14)*	Cercospora leaf spot	911

*NOTE: Pre-harvest interval (days) given in brackets following crop.

6. TOXICITY: Acute oral LD_{50} rats (mg/kg) = maneb (6,750).

7. PRECAUTIONS, FIRST AID: Do not apply or allow to drift to areas occupied by unprotected persons or to streams, lakes or ponds to protect wildlife. Avoid contamination of feed or food, including such crops on which residue is unsafe. Keep away from fire and sparks.
First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for eyes. IF SWALLOWED - induce vomiting (see page 3). Repeat until vomit is clear. Take patient to nearest hospital taking the labelled container with you.

8. STORAGE: Store product in a cool, dry place away from food or feed. Prevent the contents from becoming wet as this will reduce effectiveness and may cause flammable vapours.

9. DECONTAMINATION AND DISPOSAL: Burn empty bag; stay out of smoke.

MERTECT (thiabendazole)
Chipman

1. FORMULATION: Suspension - Flowable (45% thiabendazole)
2. HOW IT WORKS: Thiabendazole is a fungicide which controls *Fusarium, Helminthosporium, Oospora, Phoma* and *Rhizoctonia* fungi.
3. NUMBER OF APPLICATIONS: One per season.
4. HOW TO APPLY:
   With: Spray equipment.
   Rate:

Crop	Disease	mL/1000 kg potatoes
Potatoes	Storage rot	90 (suspension)

   Water Volume: 8 L product/170 L water. Spray 2 litres of this suspension per metric tonne of potatoes.
5. APPLICATION TIPS: Potatoes must rotate along the conveyor line to ensure complete coverage.
6. TOXICITY: Acute oral LD_{50} rate (mg/kg) – thiabendazole (3,300). May cause skin irritation.
7. PRECAUTIONS, FIRST AID: Consult with manufacturer before mixing with other chemicals. Wash hands, face and arms after use and before eating, drinking or smoking.
   First aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for eyes. IF SWALLOWED - do NOT induce vomiting, product contains petroleum distillates. Contact a physician.
8. DECONTAMINATION AND DISPOSAL: When cleaning equipment or disposing of wastes, do not contaminate any water sources. Do not reuse container - destroy when empty.

ROVRAL (iprodione)
May and Baker

1. FORMULATIONS: Wettable Powder (50% iprodione). Flowable (250 g iprodione/L)
2. REGISTERED MIXES: With lindane as dual purpose formulation.
3. HOW IT WORKS: Rovral is a protective and eradicant fungicide.
4. NUMBER OF APPLICATIONS: Refer to label - depends on crop.
5. HOW TO APPLY:
   With: Ground or aircraft equipment.
   Rate:

Crop	Disease	g/ac	mL/ac
Canola	*Sclerotinia*	400-600	800-1200
Beans (white, kidney, snap)	*Sclerotinia* and *Botrytis*	400-600	800-1200

   Water Volume: Canola 16 L/ac (aerial); 40 L/ac (ground). Beans 16 L/ac (aerial); 121 L/ac (ground).
6. APPLICATION TIPS: Spray mixture should be used on the day prepared. Addition of 405 g nonionic wetter is recommended for improved fungicide performance. When disease is actively growing in beans, the infection may quickly exceed the point where 5% of plants show mould. Good spray coverage is essential. Do not spray in heavy dew or when rain is imminent.
7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = iprodione (3,500).
8. PRECAUTIONS, FIRST AID: Avoid inhaling mist. A mild eye irritant. IF IN EYES or ON SKIN - use standard first aid measures (see page 3). IF SWALLOWED - if patient is concious, wash out mouth. If breathing stops, start artificial respiration. Get medical attention.
9. STORAGE: Store flowable above 0°C.
10. DECONTAMINATION AND DISPOSAL: Do not contaminate domestic or irrigation water.

THIRAM 75 & THIRAM 320 (thiram)
Uniroyal

1. FORMULATIONS: Wettable Powder - (75% thiram). Suspension - Flowable (32.4% thiram)
2. REGISTERED MIXES: In various combinations with other fungicides (benomyl and carbathiin) and, as dual purpose formulations, with insecticides (chlorfenvinphos, ethion, fensulfothion, fonophos and lindane).
3. HOW IT WORKS: Thiram is a protective fungicide applied as a foliar spray or a seed-treatment powder.
4. NUMBER OF APPLICATIONS: Seed treatments - one.
5. HOW TO APPLY:
   With: With seed-treatment equipment.
   Rate:

Crop	Disease	Qty/25 kg seed
Alfalfa	Verticillium wilt	90 g wettable powder OR 180 mL suspension
Canola, mustard, sugar beet	Seed decay, seedling blight, damping-off	100 g wettable powder
Bean (snap dry), pea, soybean	Seed decay, seedling blight, damping-off	25-35 g wettable powder
Corn (sweet)	Seed decay, seedling blight, damping-off	55 g wettable powder

6. APPLICATION TIPS: Oilseeds - mix powder and seed in drill box. Simultaneous treatment with an insecticide for control of flea beetles is recommended (see also the manual sections on carbofuran and lindane).
7. TOXICITY: Acute oral LD_{50} rats (mg/kg) = thiram (375-865). May irritate eyes, nose, throat or skin. May cause allergenic eczema in sensitive individuals.
8. PRECAUTIONS, FIRST AID: Avoid breathing dust or spray mist. When treating, augering or handling treated seed, work in a well ventilated area and wear goggles, gloves and a dust mask. Keep away from fire or sparks. Wash thoroughly after handling and before eating, drinking or smoking. Consumption of alcohol 24 hours before and after working with thiram or thiram-treated seed may cause sweating, flushing and nausea.
   First Aid: IF IN EYES or ON SKIN - use standard first aid measures (see page 3). Get medical attention for eyes.
9. STORAGE: Store in a cool, dry, ventilated place away from food or feed.
10. DECONTAMINATION AND DISPOSAL: Wash contaminated clothing with soap and hot water before wearing.

HERBICIDE SELECTOR CHART — CEREALS AND OILS

	BINDWEEDS	BLUEBUR	BUCKWHEAT (Tartary)	BUCKWHEAT (Wild)	CHAMOMILE (Scentless)	CHICKWEED (Common)	CLEAVERS	COCKLE (Cow)	DANDELION	DARNEL (Persian)	FLIXWEED	F
BARLEY	**Cobutox 400 2,4-D* Embutox E* Kil-Mor* Target* Tropotox Plus**	Asulox F* Buctril M 2,4-D MCPA* Phenoxylene Plus Regione Sabre Stampede CM	Afolan & MCPA Banvel Blagal Bromox 720 Buctril M Dyvel Estaprop Glean Hoe-Grass II Kil-Mor Lorox & MCPA MCPA* Pardner Sabre Stampede CM Target* Torch DS Tordon 202C	**Afolan & MCPA Banvel Blagal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe-Grass II Kil-Mor Lorox & MCPA MCPA* Pardner Sabre Stampede CM Target Torch DS Tordon 202C**	Bromox 720 Buctril M Hoe Grass II Pardner Sabre Torch DS Tordon 202C*	Afolan & MCPA Blagal Glean Lontrel & Mixes Lorox & MCPA Mecoturf Phenoxylene Plus Sencor & Mixes	**Banvel Dyvel Glean Kil-Mor**	Afolan & MCPA Banvel Bromox 720 Buctril M Dyvel Glean Hoe Grass II Kil-Mor Lorox & MCPA Pardner Sabre Target Torch DS	Afolan & MCPA Ammo Seedling Cobutox 400* 2,4-D* Mecoturf Phenoxylene Plus Tordon 202C	**Hoe-Grass II Hoe-Grass 284**	Blagal Bromox 720 Buctril M 2,4-D Dyvel Estaprop Glean Kil-Mor Lorox & MCPA MCPA Phenoxylene Plus Sabre Stampede CM Target	Afolan MCP Herita Hoe G Hoe-Gr Lorox Sodiu Stamp Treflan
WHEAT	**Cobutox 400* 2,4-D Butyric 400* 2,4-D* Embutox E* Kil-Mor* Phenoxylene Plus MCPA (salts)* Target* Tropotox Plus**	Buctril M 2,4-D Estaprop MCPA* Phenoxylene Plus Sabre Stampede CM	Afolan & MCPA Banvel Blagal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe-Grass II Kil-Mor Lorox & MCPA MCPA* Pardner Sabre Stampede CM Target Torch DS Tordon 202C	**Afolan & MCPA Banvel Blagal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe-Grass II Kil-Mor Lorox & MCPA MCPA* Pardner Sabre Stampede CM Target Torch DS Tordon 202C**	Bromox 720 Buctril M Hoe Grass II Pardner Sabre Torch DS Tordon 202C*	Afolan & MCPA Blagal Glean Lontrel & Mixes Lorox & MCPA Mecoturf Phenoxylene Plus Sencor & Mixes	**Banvel Dyvel Glean Kil-Mor Mecoturf***	Afolan & MCPA Banvel Bromox 720 Buctril M Dyvel Glean Hoe Grass II Kil-Mor Lorox & MCPA Pardner Sabre Target Torch DS	Afolan & MCPA Ammo Seedling Cobutox 400* 2,4-D* Mecoturf Phenoxylene Plus Tordon 202C	**Hoe-Grass II Hoe-Grass 284**	Blagal Bromox 720 Buctril M 2,4-D MCPA Phenoxylene Plus Sabre Stampede CM Target	Afolan MCP Herita Hoe G Hoe-Gr Lorox Stamp Treflan
OATS	**Cobutox 400* Embutox E* Kil-Mor* Target* Tropotox Plus**	Buctril M MCPA* Phenoxylene Plus Sabre Stampede CM	Afolan & MCPA Banvel Blagal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Kil-Mor Lorox & MCPA MCPA* Pardner Sabre Stampede CM Target Torch DS	**Afolan & MCPA Banvel Blagal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Glean Kil-Mor Lorox & MCPA MCPA* Pardner Sabre Stampede CM Target Torch DS**	Bromox 720 Buctril M Pardner Sabre Torch DS	Afolan & MCPA Blagal Glean Lorox & MCPA Mecoturf Phenoxylene Plus	**Banvel Dyvel Glean Kil-Mor* Mecoturf* Pardner***	Afolan & MCPA Banvel Bromox 720 Buctril M Dyvel Glean Kil-Mor Lorox & MCPA Pardner Sabre Target Torch DS	Afolan & MCPA Ammo Seedling Cobutox 400* Mecoturf Phenoxylene Plus		Blagal Bromox 720 Buctril M Dyvel Kil-Mor Lorox & MCPA MCPA Phenoxylene Plus Sabre Stampede CM Target	Afolan MCP Lorox Sodium Stampe
RAPESEED (TTC - triazine tolerant canola)	**Regione!!**	Regione	Lontrel* Regione Sencor TTC Spectrum Treflan*	**Bladex (TTC) Lontrel* Regione!! Rival Spectrum Treflan**	Lontrel Regione*	Bladex TTC Regione!! Rival Sencor TTC Spectrum Treflan	**Benazolin* Bladex (TTC) Lontrel* Regione!!**	Regione!! Rival Spectrum Treflan	Regione!!	**Hoe-Grass 284 Poast Regione!! Rival Spectrum Treflan**	Regione!!	Dalapo Hoe Gr Poast Regione Rival Sodium Spectru Treflan
RYE (Spring Application)	**2,4-D* MCPA* Tropotox Plus**	Buctril M 2,4-D MCPA* Sabre	Banvel Bromox 720 Buctril M MCPA* Pardner Sabre Torch DS Tropotox Plus	**Banvel Buctril M MCPA* Pardner Sabre Torch DS Tropotox Plus***	Bromox 720 Buctril M Sabre Pardner Torch DS		**Banvel**	Banvel Bromox 720 Buctril M Pardner Sabre Torch DS	2,4-D*	**Hoe-Grass 284**	Bromox 720 Buctril M 2,4-D MCPA Sabre	Hoe Gr Spectru
FLAX	**Basagran 2,4-D* Regione!!**	Asulox F* Buctril M 2,4-D MCPA* Phenoxylene Plus Regione Sabre Stampede CM	Blagal Bromox 720 Buctril M Hoe Grass II MCPA* Pardner Regione!! Sabre Stampede CM Torch DS Treflan	**Asulox F* Blagal Buctril M Hoe-Grass II MCPA* Pardner Regione!! Rival Sabre Stampede CM Torch DS Treflan**	Bromox 720 Buctril M Hoe Grass II Pardner Regione Sabre Torch DS	Basagran Blagal Eptam Phenoxylene Plus Regione!! Rival Treflan	**Regione!!**	Bromox 720 Buctril M Hoe Grass II Pardner Regione!! Rival Sabre Torch DS Treflan	2,4-D* Phenoxylene Plus Regione!!	**Fusilade Hoe-Grass II Hoe-Grass 284 Poast Regione!! Rival Treflan**	Blagal Bromox 720 Buctril M 2,4-D MCPA Phenoxylene Plus Regione!! Sabre Stampede CM	Asulox Dalapo Eptam Fusilad Hoe Gra Hoe Gr Poast Regione Rival Sodium Stampe Treflan
MUSTARD			Treflan*	**Rival Treflan**		Rival Treflan		Rival Treflan		**Hoe-Grass 284 Rival Treflan**		Hoe Gr Rival Treflan

* Suppression only
‡ Weeds controlled or suppressed based on preliminary data
• Pre crop emergence to weed seedlings
~ Used as a crop desiccant

) OILSEEDS

FLIXWEED	FOXTAIL (Green)	GRASS (Barnyard)	GROUNDSEL (Common)	HAWK'S BEARD (Narrow-Leaved)	HEMP-NETTLE	HENBIT	HORSETAIL (Field)	KNAWEL	KOCHIA	LAMB'S-QUARTERS	MUSTARDS, RAPESEED (Volunteer)	OATS (Wild, Volunteer)	P (P
...72C ...M ... ...& MCPA ...PA ...xylene ...Plus ... ...ade CM ...DS	Afolan & MCPA* Hoe Grass Hoe Grass 284 Lorox & MCPA Sodium TCA Stampede CM Treflan	**Afolan F & MCPA Amine** **Hoe-Grass II** **Hoe-Grass 284** **Lorox & MCPA** **Sodium TCA**	Afolan & MCPA Bromox 720 Buctril M Hoe Grass II Lorox & MCPA Pardner Sabre Sencor Torch DS	Embutox E & MCPA	**Afolan & MCPA** **Biagal** **Buctril M & MCPA** **Dyvel** **Glean** **Laxone** **Lorox & MCPA** **MCPA*** **MCPA-K84** **Sencor & Mixes** **Target** **Tropotox Plus**	Laxone & Mixes Sencor & Mixes	Afolan* Biagal* Cobutox 400* 2,4-D*	**Buctril M** **Hoe-Grass II** **Pardner** **Sabre** **Torch DS**	Afolan & MCPA Bromox 720 Buctril M 2,4-D Dyvel Estaprop Glean Hoe Grass II Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Stampede CM Target Torch DS	Afolan & MCPA Biagal Bromox 720 Buctril M 2,4-D Dyvel Embutox E Estaprop Glean Hoe Grass II Kil-Mor Laxone & Mixes Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Sencor & Mixes Stampede CM Target Torch DS Tordon 202C Tropotox Plus	**Afolan & MCPA** **Biagal** **Bromox 720** **Buctril M** **Cobutox 400** **2,4-D** **2,4-D Butyric 400** **Dyvel** **Embutox E** **Estaprop** **Glean** **Hoe-Grass II** **Kil-Mor** **Laxone & Mixes** **Lorox** **MCPA** **Pardner** **Phenoxylene Plus** **Sabre** **Sencor & Mixes** **Stampede CM** **Target** **Torch DS** **Tordon 202C** **Tropotox Plus**	Avadex BW Avenge 200C Carbyne 2EC Hoe Grass II Hoe Grass 284	A 2,4- Dyv K Lor MC Tro
... ...

OATS (Wild, Volunteer)	PIGWEED (Prostrate)	PIGWEED (Redroot)	RADISH (Wild)	RAGWEED	SHEPHERD'S PURSE	SMARTWEED (Lady's-Thumb)	SOW-THISTLES (Annual and Perennial)	SPURGE (Leafy)	SPURRY (Corn)	STINKWEED	STORK'S-BILL	THISTLE (Canada)	T (I
...ne BW ...e 200C ...e 2EC ... ...ass 284	Afolan & MCPA 2,4-D Dyvel ... M ... & MCPA MCPA ... Target	**Afolan & MCPA Balgal Bromox 720 Buctril M Cobutox 400 2,4-D* 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe-Grass II Kil-Mor Lexone Lorox & MCPA MCPA Phenoxylene Plus Sabre Sencor & Mixes Stampede CM Target Torch DS Tordon 202C Torpotox Plus**	Afolan & MCPA Balgal 2,4-D Dyvel Embutox E ... & MCPA MCPA*	Afolan & MCPA Balgal* Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Kil-Mor Lorox & MCPA MCPA Pardner Phenoxylene Plus Target Tropotox Plus	**Afolan & MCPA Balgal* Bromox 720 Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Kil-Mor Lexone Lorox & MCPA MCPA* Phenoxylene Plus Sabre Stampede CM Target Tordon 202C* Tropotox Plus**	Afolan & MCPA Balgal Bromox 720 Buctril M ... 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe Grass II Kil-Mor Lexone & Mixes Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Sencor & Mixes Stampede CM Target Torch DS Tordon 202C Tropotox Plus	Afolan & MCPA (P seedlings) Banvel* (P) Balgal** (P) Bromox 720* (P) Buctril M* (P) 2,4-D* Dyvel* Embutox E Estaprop* Kil-Mor (A) Lorox & MCPA (A) MCPA* Phenoxylene Plus (A) Sabre* (P) Target (A) Tordon 202C* Tropotox Plus (A)	**Banvel** 2,4-D* MCPA***	Afolan & MCPA Banvel Balgal Dyvel Kil-Mor Lexone & Mixes Lorox & MCPA Mecoturf Sencor & Mixes Target	Afolan & MCPA Balgal Bromox 720 Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe Grass II Kil-Mor Lexone & Mixes Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Sencor & Mixes Stampede CM Target Torch DS Tordon 202C Tropotox Plus	**Afolan & MCPA Estaprop Lorox & MCPA**	Banvel* Balgal* Bromox 720* Buctril M* Cobutox 400* 2,4-D* Dyvel* Embutox E* Estaprop* Glean Kil-Mor** Lexone & Mixes Lorox & MCPA* MCPA* Mecoturf* Sabre* Sencor (mixes) Target* Tordon 202C* Tropotox Plus	Brom Buctri 2,4-D Dyvel Fusi Estap Glean Hoe G Kil-M MCPA Pardn Sabre Sencor Target Torch Tordo Trefla
...ne BW ...e 200C ...e 2EC ... ...ass 284	Afolan & MCPA 2,4-D Dyvel ... M ... & MCPA MCPA ... Target	**Afolan & MCPA Balgal Bromox 720 Buctril M Cobutox 400 2,4-D* 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe-Grass II Kil-Mor Lexone Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Sencor & Mixes Stampede CM Target Torch DS Tordon 202C Tropotox Plus**	Afolan & MCPA Balgal 2,4-D Dyvel Embutox E ... & MCPA MCPA*	Afolan & MCPA Balgal* Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop ... M ... Lorox & MCPA MCPA Pardner Phenoxylene Plus Target Tropotox Plus	**Afolan & MCPA Balgal* Bromox 720 Buctril M* Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Kil-Mor Lexone Lorox & MCPA MCPA* Phenoxylene Plus Sabre Stampede CM Target Tropotox Plus**		Afolan & MCPA (P seedlings) Banvel* (P) Balgal** (P) Bromox 720* (P) Buctril M* (P) 2,4-D* Dyvel* Embutox E Estaprop* ... M ... A Lorox & MCPA (A) MCPA* Phenoxylene Plus (A) Sabre* (P) Target (A) Tordon 202C* Tropotox Plus	**Banvel** 2,4-D* MCPA***	Afolan & MCPA Banvel Balgal Dyvel Kil-Mor Lexone & Mixes Lorox & MCPA Mecoturf Sencor & Mixes Target	Afolan & MCPA Balgal Bromox 720 Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe Grass II Kil-Mor Lexone & Mixes Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Sencor & Mixes Stampede CM Target Torch DS Tordon 202C Tropotox Plus	**Afolan & MCPA Estaprop Lorox & MCPA**	... Balgal* ... 720* Buctril M* Cobutox 400* 2,4-D* Dyvel* Embutox E* Estaprop* Glean Kil-Mor** Lexone & Mixes Lorox & MCPA* MCPA* Mecoturf* Sabre* Sencor (mixes) Target* Tordon 202C* Tropotox Plus	Brom Buctri 2,4-D Dyvel Estap Glean Kil-M MCPA Pardn Sabre Sencor Target Torch Tordo Trefla
	Afolan & MCPA Dyvel ... M ... & MCPA MCPA Target	**Afolan & MCPA Balgal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Glean Kil-Mor Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Stampede CM Target Torch DS Tropotox Plus**	Afolan & MCPA Balgal Dyvel ... & MCPA MCPA*	Afolan & MCPA Balgal* Buctril M ... 400 2,4-D Butyric 400 Dyvel Embutox E ... M ... Lorox & MCPA MCPA Pardner Phenoxylene Plus Target Tropotox Plus	**Afolan & MCPA Balgal* Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Kil-Mor Lorox & MCPA MCPA* Phenoxylene Plus Sabre Stampede CM Target Tropotox Plus**	Afolan & MCPA Balgal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Glean Kil-Mor Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Stampede CM Target Torch DS Tropotox Plus	Afolan & MCPA (P seedlings) Banvel* (P) Balgal** (P) Bromox 720* (P) Buctril M* (P) Dyvel* Embutox E Kil-Mor (A) Lorox & MCPA (A) MCPA* Phenoxylene Plus (A) Sabre* (P) Target Torpotox Plus	**Banvel** MCPA***	Afolan & MCPA Banvel Balgal Dyvel Kil-Mor Lorox & MCPA Mecoturf Target	Afolan & MCPA Balgal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Glean Kil-Mor Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Stampede CM Target Torch DS Tropotox Plus	**Lorox & MCPA* Afolan & MCPA**	Banvel* Balgal* Bromox 720* Buctril M* Cobutox 400* Dyvel* Embutox E* Glean Kil-Mor** Lorox & MCPA* MCPA* Mecoturf* Sabre* Target* Tropotox Plus	Brom Buctri Dyvel Glean Kil-M MCPA Pardn Sabre Target Torch Trefla
...ne BW ...e 2EC ...ass 284	Regione!! Rival Treflan	**Bladex (TTC) Lontrel* Regione!! Rival Sencor (TTC) Spectrum Treflan**	Regione!!	Lontrel Regione!	**Bladex (TTC) Regione!! Spectrum**	Regione!! Sencor (TTC) Spectrum	Lontrel* Regione!!	**Regione!!**	Regione!! Sencor (TTC)	Regione!! Sencor (TTC) Spectrum	**Regione!!**	Benazolin* Lontrel* Regione!!	Regione Rival Sencor Spectru Treflan
...ge 200C ...rass 284	2,4-D MCPA	**Bromox 720 Buctril M 2,4-D* MCPA Pardner Sabre Torch DS Tropotox Plus**	2,4-D MCPA* Tropotox Plus	Bromox 720 Buctril M 2,4-D MCPA* Sabre Tropotox Plus	Bromox 720 Buctril M ... Banvel MCPA* Pardner Sabre Torch DS Tropotox Plus	Brumox 720* (P) Buctril M* (P) 2,4-D* MCPA* (A) Sabre* (P) Tropotox Plus	**Banvel 2,4-D* MCPA***	Banvel	Brumox 720 Buctril M 2,4-D MCPA Pardner Sabre Torch DS Tropotox Plus		2,4-D* MCPA* Tropotox Plus	2,4-D* MCPA Pardner Torch DS
... F ...e BW ...e 2EC ... ...ass II ...ass 284 ...	2,4-D Eptam MCPA Regione!! Rival Treflan	**Basagran Balgal Bromox 720 Buctril M 2,4-D Hoe-Grass II Eptam MCPA* Pardner Phenoxylene Plus Regione!! Rival Sabre Stampede CM Torch DS Treflan**	Balgal 2,4-D MCPA* Regione!!	Basagran Balgal* Buctril M 2,4-D MCPA* Phenoxylene Plus Regione!!	**Basagran Balgal* Bromox 720 Buctril M 2,4-D MCPA* Phenoxylene Plus Regione!! Sabre Stampede CM**	Asulox F* Basagran Balgal Bromox 720 Buctril M 2,4-D Hoe Grass II MCPA Pardner Phenoxylene Plus Regione!! Sabre Stampede CM Torch DS	Balgal** Bromox 720* (P) Buctril M* 2,4-D* (A) MCPA* (A) Phenoxylene Plus (A) Regione!! Sabre* (P)	**2,4-D* MCPA* Regione!!**	Basagran Balgal Eptam Regione!!	Asulox F* Basagran Balgal Bromox 720 Buctril M 2,4-D Hoe Grass II MCPA Pardner Phenoxylene Plus Regione!! Sabre Stampede CM Torch DS	**Regione!!**	Basagran Balgal* Bromox 720* Buctril M* MCPA* Regione!! Sabre*	Basagran Bromox Buctril M 2,4-D* Hoe-Gras MCPA Regione Rival Sabre Torch DS Treflan
... BW ...e 2EC ...ass 284	Rival Treflan	**Rival Treflan**											Rival Treflan

RADISH (Wild)	RAGWEED	SHEPHERD'S PURSE	SMARTWEED (Lady's-Thumb)	SOW-THISTLES (Annual and Perennial)	SPURGE (Leafy)	SPURRY (Corn)	STINKWEED	STORK'S-BILL	THISTLE (Canada)	THISTLE (Russian)	TOADFLAX	VOLUNTEER CEREALS
Afolan & MCPA Biagal 2,4-D Dyvel Embutox E Lorox & MCPA MCPA*	Afolan & MCPA Biagal* Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Kil-Mor Lorox & MCPA MCPA Pardner Phenoxylene Plus Target Tropotox Plus	**Afolan & MCPA** **Biagal*** **Bromox 720** **Buctril M** **Cobutox 400** **2,4-D** **2,4-D Butyric 400** **Dyvel** **Embutox E** **Estaprop** **Kil-Mor** **Lorox & MCPA** **MCPA*** **Phenoxylene Plus** **Sabre** **Stampede CM** **Target** **Tordon 202C*** **Tropotox Plus**	Afolan & MCPA Biagal Bromox 720 Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe Grass II Kil-Mor Lexone & Mixes Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Sencor & Mixes Stampede CM Target Torch DS Tordon 202C Tropotox Plus	Afolan & MCPA (P seedlings) Banvel* (P) Biagal**	**Banvel***** **2,4-D*** **MCPA***	Afolan & MCPA Banvel Biagal Dyvel Kil-Mor Lexone & Mixes Lorox & MCPA Mecoturl Sencor & Mixes Target	Afolan & MCPA Biagal Bromox 720 Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe Grass II Kil-Mor Lexone & Mixes Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Sencor & Mixes Stampede CM Target Torch DS Tordon 202C Tropotox Plus	**Afolan & MCPA** **Estaprop** **Lorox & MCPA**	Banvel* Biagal* Bromox 720* Buctril M* Cobutox 400* 2,4-D* Dyvel* Embutox E* Estaprop* Glean Kil-Mor** Lexone & Mixes Lorox & MCPA* MCPA* Mecoturl** Sabre* Sencor & Mixes Target* Tordon 202C* Tropotox Plus	Bromox 720* Buctril M* 2,4-D* Dyvel Estaprop* Glean Hoe Grass II Kil-Mor MCPA Pardner Sabre Sencor & Mixes Target Torch DS Tordon 202C Trefl an	**2,4-D*** **Estaprop***	
Afolan & MCPA Biagal 2,4-D Dyvel Embutox E Lorox & MCPA MCPA*	Afolan & MCPA Biagal* Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Kil-Mor Lorox & MCPA MCPA Pardner Phenoxylene Plus Target Tropotox Plus	**Afolan & MCPA** **Biagal*** **Bromox 720** **Buctril M*** **Cobutox 400** **2,4-D** **2,4-D Butyric 400** **Dyvel** **Embutox E** **Estaprop** **Kil-Mor** **Lexone** **Lorox & MCPA** **MCPA*** **Phenoxylene Plus** **Sabre** **Stampede CM** **Target** **Tropotox Plus**		Afolan & MCPA (P seedlings) Banvel* (P) Barigal** Bromox 720* (P) Buctril M* (P) 2,4-D* Dyvel* Embutox E Estaprop* Kil-Mor (A) Lorox & MCPA (A) MCPA* Phenoxylene Plus (A) Sabre* (P) Target (A) Tordon 202C* Tropotox Plus	**Banvel***** **2,4-D*** **MCPA***	Afolan & MCPA Banvel Biagal Dyvel Kil-Mor Lexone & Mixes Lorox & MCPA Mecoturl Sencor & Mixes Target	Afolan & MCPA Biagal Bromox 720 Buctril M Cobutox 400 2,4-D 2,4-D Butyric 400 Dyvel Embutox E Estaprop Glean Hoe Grass II Kil-Mor Lexone & Mixes Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Sencor & Mixes Stampede CM Target Torch DS Tordon 202C Tropotox Plus	**Afolan & MCPA** **Estaprop** **Lorox & MCPA**	Banvel* Biagal* Bromox 720* Buctril M* Cobutox 400* 2,4-D* Dyvel* Embutox E* Estaprop* Glean Kil-Mor** Lexone & Mixes Lorox & MCPA* MCPA* Mecoturl** Sabre* Sencor & Mixes Target* Tordon 202C* Tropotox Plus	Bromox 720 Buctril M 2,4-D* Dyvel Estaprop Glean Hoe Grass II Kil-Mor MCPA Pardner Sabre Sencor & Mixes Target Torch DS Tordon 202C Trefl an	**2,4-D*** **Estaprop***	
Afolan & MCPA Biagal Dyvel Lorox & MCPA MCPA*	Afolan & MCPA Biagal* Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Kil-Mor Lorox & MCPA MCPA Pardner Phenoxylene Plus Target Tropotox Plus	**Afolan & MCPA** **Biagal*** **Bromox 720** **Buctril M** **Cobutox 400** **2,4-D Butyric 400** **Dyvel** **Embutox E** **Kil-Mor** **Lorox & MCPA** **MCPA*** **Phenoxylene Plus** **Sabre** **Stampede CM** **Target** **Tropotox Plus**	Afolan & MCPA Biagal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Glean Kil-Mor Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Stampede CM Target Torch DS Tropotox Plus	Afolan & MCPA (P seedlings) Banvel* (P) Biagal** Bromox 720* (P) Buctril M* (P) Dyvel* Embutox E Kil-Mor (A) Lorox & MCPA (A) MCPA* Phenoxylene Plus (A) Sabre* (P) Target Tropotox Plus	**Banvel***** **MCPA***	Afolan & MCPA Banvel Biagal Dyvel Kil-Mor Lorox & MCPA Mecoturl Target	Afolan & MCPA Biagal Bromox 720 Buctril M Cobutox 400 2,4-D Butyric 400 Dyvel Embutox E Glean Kil-Mor Lorox & MCPA MCPA Pardner Phenoxylene Plus Sabre Stampede CM Target Torch DS Tropotox Plus	**Lorox & MCPA*** **Afolan & MCPA**	Banvel* Biagal* Bromox 720* Buctril M* Cobutox 400* Dyvel* Embutox E* Glean Kil-Mor** Lorox & MCPA* MCPA* Mecoturl** Sabre* Target* Tropotox Plus	Bromox 720 Buctril M Dyvel Glean Kil-Mor MCPA* Pardner Sabre Target Torch DS Trefl an	**MCPA***	
Regione**	Lontrel Regione**	**Blades (TTC)** **Regional†** **Spectrum**	Regione** Sencor (TTC) Spectrum	Lontrel* Regione**	**Regione†**	Regione** Sencor (TTC)	Regione** Sencor (TTC) Spectrum	**Regione†**	Benazolin* Lontrel Regione	Regione** Rival Sencor (TTC) Spectrum Trefl an	**Regional†**	Poast* Regione
2,4-D MCPA*	2,4-D MCPA Tropotox Plus	**Bromox 720** **Buctril M** **2,4-D** **MCPA*** **Sabre** **Tropotox Plus**	Bromox 720 Buctril M Banvel MCPA* Pardner Sabre Torch DS Tropotox Plus	Bromox 720* (P) Buctril M* (P) 2,4-D* MCPA* (A) Sabre* (P) Tropotox Plus	**Banvel*** **2,4-D*** **MCPA***	Banvel	Bromox 720 Buctril M 2,4-D MCPA Pardner Sabre Torch DS Tropotox Plus		2,4-D* MCPA* Tropotox Plus	2,4-D* MCPA Pardner Torch DS		
Blagal 2,4-D MCPA* Regione**	Basagran Blagal* Buctril M 2,4-D MCPA* Phenoxylene Plus Regione**	**Basagran** **Blagal*** **Bromox 720** **Buctril M** **2,4-D** **MCPA*** **Phenoxylene Plus** **Regional†** **Sabre** **Stampede CM**	Asulox F* Basagran Blagal Bromox 720 Buctril M 2,4-D Hoe Grass II MCPA Pardner Phenoxylene Plus Regione** Sabre Stampede CM Torch DS	Blagal** Bromox 720* (P) Buctril M 2,4-D* (A) MCPA* (A) Phenoxylene Plus (A) Regione** Sabre* (P)	**2,4-D*** **MCPA*** **Regional†**	Basagran Blagal Eptam Regione**	Asulox F* Basagran Blagal Bromox 720 Buctril M 2,4-D Hoe Grass II MCPA Pardner Phenoxylene Plus Regione** Sabre Stampede CM Torch DS	**Regional†**	Basagran Blagal* Bromox 720* Buctril M* MCPA* Regione** Sabre*	Basagran Bromox 720 Buctril M 2,4-D* Hoe Grass II MCPA Regione** Rival Sabre Torch DS Trefl an	**MCPA*** **Regional†**	Asulox F* Eptam Fusilade Poast* Regione
										Rival Trefl an		

HERBICIDE SELECTOR CHART - FORAGE CR

CROP	CROP STAGE	Absinth	BARLEY (Foxtail)	BINDWEED (Field)	BLUEBUR	BRUSH (Alder, Aspen, Choke Cherry, Pasture Sage, Silverberry, Western Snowberry Wild Rose, Willow)	BUCKWHEAT (Wild)	CATCHFLY Night-Flowering	CHAMO (Scent
Alfalfa (irr) under irrigation	Seedling		Eptam (ppi) Kerb	Cobutox 400* 2,4-D Butyric 400* Embutox E*	Asulox F@*	Mow	Asulox F@* Cobutox 400 2,4-D Butyric 400 Embutox E		
	Established	Regione!!	Kerb Princep Regione!! Sinbar*	Regione!!	Asulox F@* Princep Regione!! Sinbar	Mow		Princep Sumadex Sencor (irr) Regione!!	Regione!!
Alsike Clover	Seedling			Cobutox 400* 2,4-D Butyric 400* Embutox E* Tropotox Plus		Mow	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus*		
	Established					Mow			
Red Clover	Seedling			Tropotox Plus		Mow	Tropotox Plus*		
	Established	Regione!!	Regione!!	Regione!!	Regione!!	Mow	Regione!!	Regione!!	Regione!!
White Dutch Clover	Seedling			Cobutox 400* 2,4-D Butyric 400* Embutox E* Tropotox Plus		Mow	Cobutox 400 2,4-D Butyric 400 Embutox		
	Established	Regione!!	Regione!!	Regione!!	Regione!!	Mow	Regione!!	Regione!!	Regione!!
Sweet Clover	Seedling					Mow			
	Established					Mow			
Bird's-foot Trefoil	Seedling		Eptam (ppi) Kerb	Cobutox 400* 2,4-D Butyric 400* Embutox E*		Mow	Cobutox 400 2,4-D Butyric 400 Embutox		
	Established	Regione!!	Kerb Princep Regione!!		Princep Regione!!	Mow	Princep Regione!!	Princep Regione!!	Regione!!
Sainfoin	Seedling					Mow			
	Established					Mow			
Brome grass	Seedling				Buctril M	Mow	Buctril M Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS
	Established	2,4-D* Mow & 2,4-D		2,4-D*	2,4-D	2,4-D* Mow	MCPA		
Crested Wheatgrass	Seedling				Buctril M	Mow	Buctril M Pardner Torch Torch DS	Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS
	Established	2,4-D* Mow & 2,4-D		2,4-D*	2,4-D	2,4-D* Mow			
Intermediate Wheatgrass	Seedling				Buctril M	Mow	Buctril M Pardner Torch Torch DS	Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS
Seed Only	Established	2,4-D* Mow & 2,4-D		2,4-D*	2,4-D	2,4-D* Mow			
Creeping Red Fescue	Seedling			Banvel*	Buctril M	Banvel@ Mow		Pardner Torch Torch DS	Banvel* Buctril M Pardner Torch Torch DS
	Established	Mow & 2,4-D		Banvel* Banvel & 2,4-D*	2,4-D	Banvel Banvel & 2,4-D Mow	Banvel		Banvel
Russian Wild Rye	Seedling				Buctril M	Mow	Buctril M Pardner Torch Torch DS	Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS
	Established	Mow & 2,4-D		2,4-D*	2,4-D	2,4-D Mow			
Timothy	Seedling				Buctril M	Mow	Buctril M Pardner Torch Torch DS	Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS
	Established					Mow			
Hay and Grazing	With Legumes		Kerb	Cobutox 400* 2,4-D Butyric 400* Embutox E* Tropotox Plus		2,4-D Ester - Dormant Season	Cobutox 400 2,4-D Butyric 400 Embutox Tropotox Plus*		
	No Legumes	Banvel* @ MCPA* Mow & 2,4-D@	Kerb	Banvel* Cobutox 400* 2,4-D* 2,4-D Butyric 400* Embutox E@ Tropotox Plus	Banvel@ 2,4-D MCPA	Banvel 2,4-D	Banvel* Cobutox 400 2,4-D* 2,4-D Embutox E MCPA*	Banvel@	

AGE CROPS

CATCHFLY Night-Flowering	CHAMOMILE (Scentless)	CHICKWEED	DANDELION	FOXTAIL (Green)	GRASS (Barnyard)	GRASS (Quack)	GROUNDSEL (Common)	HAWK'S-BEARD (Narrow-Leaved)	KNAPWEED (Diffuse, Spotted)	
		Kerb Eptam (ppi)	Cobutox 400 2, 4-D Butyric Embutox E*	Asulox F@* Kerb Dalapon@ Eptam (ppi) Fusilade@ Hoe-Grass 284@	Asulox F*@ Kerb Dalapon@ Eptam (ppi) Fusilade@ Hoe-Grass 284@	Amitrol T (spot)@ Dalapon@ Fusilade@ Kerb	Embutox E*	Embutox E & MCPA		Cot 2,4- Em Ept
[illegible]	Regione	[illegible]	Regione!! Sinbar*	Asulox F [illegible] Princep Dalapon [illegible] Regione!! Fusilade [illegible] Sinbar* Kerb	Asulox F [illegible] Princep Dalapon [illegible] Regione!! Fusilade [illegible] Kerb	Amitrol T Kerb (spot)@ Regione!! Dalapon@ Sinbar* Fusilade	Princep Regione!! Sencor (!!!)	Embutox E & MCPA (Fall Spraying) Regione!!	Regione!!!	Pr Re Sen
			Cobutox 400 2, 4-D Butyric Embutox E* Tropotox Plus*			Amitrol T (spot)@	Embutox E* Tropotox Plus*	Embutox E & MCPA		Co 2,4 Em Tro
						Amitrol T (spot)@				
			Tropotox Plus*	Fusilade@ Hoegrass 284@	*Fusilade* @ Hoegrass 284@	Amitrol T (spot)@ Fusilade@	Tropotox Plus*			Tro
egione!!	Regione	Regione!!	Regione!!	Fusilade Regione!!	Fusilade@ Regione!!	Amitrol T (spot)@ Fusilade@ Regione!!	Regione!!	Regione!!	Regione!!!	Re
			Cobutox 400 2, 4-D Butyric Embutox E*			Amitrol T (spot)@	Embutox E* Tropotox Plus*	Embutox E & MCPA		C 2 E T
egione!!	Regione	Regione!!	Regione!!	Regione!!	Regione!!	Amitrol T (spot)@ Regione!!	Regione!!	Regione!!	Regione!!!	
				Hoegrass 284@	Hoegrass 284@	Amitrol T (spot)@				
						Amitrol T (spot)@				
		Eptam (ppi) Kerb	Cobutox 400* Embutox E* 2,4-D Butyric	Dalapon@ Eptam (ppi) Fusilade@ Kerb	Dalapon@ Eptam (ppi) Fusilade@ Kerb	Amitrol T (spot)@ Dalapon@ Fusilade@ Kerb	Embutox E*	Embutox E & MCPA		C 2 E E
Princep Regione!!	Regione	Kerb Princep Regione!!	Regione!!	Dalapon@ Fusilade@ Kerb Princep Regione!!	Dalapon@ Fusilade@ Kerb Princep Regione!!	Amitrol T Regione!! (spot)@ Dalapon@ Fusilade@ Kerb	Princep Regione!!	Regione!!	Regione!!!	
						Amitrol T (spot)@				
						Amitrol T (spot)@				
Buctril M Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS			Hoegrass 284@	Hoegrass 284@	Amitrol T (spot)@	Buctril M Pardner Torch Torch DS			
			2,4-D			Amitrol T (spot)@		2,4-D (Fall Spraying)	2,4-D (seedling control only)*	
Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS			Hoe-Grass 284@	Hoe-Grass 284@	Amitrol T (spot)@	Buctril M Pardner Torch Torch DS			
			2,4-D			Amitrol T (spot)@			2,4-D (seedling control only)*	
Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS			Hoegrass 284@	Hoegrass 284@	Amitrol T (spot)@	Buctril M Pardner Torch Torch DS			
			2,4-D			Amitrol T (spot)@			2,4-D (seedling control only)*	
Pardner Torch Torch DS	Banvel*@ Buctril M Pardner Torch Torch DS			Hoe-Grass 284@	Hoe-Grass 284@	Amitrol T (spot)@	Buctril M Pardner Torch Torch DS			
	Banvel*@		2,4-D			Amitrol T (spot)@			2,4-D (seedling control only)*	
Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS			Hoe-Grass 284@	Hoe-Grass 284@	Amitrol T (spot)@	Buctril M Pardner Torch Torch DS			
			2,4-D			Amitrol T (spot)@			2,4-D (seedling control only)*	
Pardner Torch Torch DS	Buctril M Pardner Torch Torch DS					Amitrol T (spot)@	Buctril M Pardner Torch Torch DS			
						Amitrol T (spot)@				
		Kerb	Cobutox 400 2,4-D Butyric 400 Embutox E* Tropotox Plus*			Amitrol T (spot)@		Cobutox 400 2,4-D Butyric 400 Embutox (Fall Spraying)		
Banvel*@	Banvel*@	Kerb	Banvel Cobutox 400 2,4-D Butyric 400 2,4-D@ Embutox E* Tropotox Plus					2,4-D* (Fall Applied) Cobutox 400 2,4-D Butyric 400 Embutox	Banvel@ 2,4-D*	

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HAPWEED use, Spotted)	LAMB'S-QUARTERS	LETTUCE (Blue)	MUSTARDS	OATS (Wild)	PIGWEED (Prostrate, Redroot Tumble)	SHEPHERD'S PURSE	SMARTWEEDS	SOW-THISTLE (Annual, Perennial)	SPURGE (Leafy)	STI
	Cobutox 400 2,4-D Butyric 400 Embutox E Eptam (ppi)	Embutox E*	Asulox F* @ Cobutox 400 2,4-D Butyric 400 Embutox E	Asulox F@ Fusilade@ Avadex BW@ Hoe-Grass 284@ Avenge 200C@ Kerb Carbyne 2EC@ Mataven@ Eptam (ppi)	Cobutox 400 2,4-D Butyric 400 Embutox E Eptam (ppi)	Cobutox 400 2,4-D Butyric 400 Embutox E	Asulox F@ Cobutox 400 2,4-D Butyric 400 Embutox E	Amitrol T (spot)@ Cobutox 400*	Amitrol T (spot)@	Asulox Cobutox 2,4-D Bu Embuto
...ed!!	Princep Regione!! Sencor (m Sinbar	Princep Regione!!	Asulox F@ Sinbar Princep Regione!! Sencor (m	Asulox F Kerb Princep	Regione!! Sencor (m Sinbar	Regione!! Sinbar	Asulox F@ Sinbar Princep Regione!! Sencor (m	Amitrol T (spot)@ Regione!! Sinbar (annual)	Amitrol T (spot)@ Regione!!	
	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Embutox E* Tropotox Plus*	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Avadex BW@ Carbyne 2EC@	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Amitrol T (spot)@ Cobutox 400* Embutox E Tropotox Plus	Amitrol T (spot)@	Cobutox 2,4-D Bu Embutox Tropoto
				Carbyne 2EC				Amitrol T (spot)@	Amitrol T (spot)@	
	Tropotox Plus	Tropotox Plus*	Tropotox Plus	Avadex BW@ Avenge 200C@ Carbyne 2EC@ Fusilade@ Hoe-Grass 284@ Mataven@	Tropotox Plus	Tropotox Plus	Tropotox Plus	Amitrol T (spot)@ Tropotox Plus	Amitrol T (spot)@	Tropoto
...ed!!	Regione	Regione	Regione!!	Fusilade Regione	Regione!!	Regione!!	Regione	Amitrol T (spot)@ Regione!!	Amitrol T (spot)@ Regione!!	
	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Embutox E*	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Avadex BW@	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Amitrol T (spot)@ Cobutox 400* Embutox E Tropotox Plus	Amitrol T (spot)@	Cobutox 2,4-D Bu Embutox Tropoto
...ed!!	Regione	Regione	Regione!!	Regione	Regione!!	Regione!!	Regione!!	Amitrol T (spot)@ Regione!!	Amitrol T (spot)@ Regione!!	Regione
				Avadex BW@ Avenge 200C@ Carbyne 2EC@ Hoe-Grass 284@				Amitrol T (spot)@	Amitrol T (spot)@	
				Carbyne 2EC				Amitrol T (spot)@	Amitrol T (spot)@	
	Cobutox 400 2,4-D Butyric 400 Embutox E Eptam (ppi)	Embutox E*	Cobutox 400 2,4-D Butyric 400 Embutox E	Avadex BW@ Avenge 200@ Eptam (ppi) Fusilade@ Kerb Mataven@	Cobutox 400 2,4-D Butyric 400 Embutox E Eptam (ppi)	Cobutox 400 2,4-D Butyric 400 Embutox E	Cobutox 400 2,4-D Butyric 400 Embutox E	Amitrol T (spot)@ Cobutox 400* Embutox E	Amitrol T (spot)@	Cobutox 2,4-D Bu Embutox
...ed!!	Princep Regione!!	Princep Regione!!	Princep Regione!!	Fusilade Kerb Princep Regione!!	Princep Regione!!	Princep Regione!!!	Princep Regione!!	Amitrol T (spot)@ Regione!!	Amitrol T (spot)@ Regione!!	Princep Regione
				Mataven@				Amitrol T (spot)@	Amitrol T (spot)@	
								Amitrol T (spot)@	Amitrol T (spot)@	
	Buctril M Pardner Torch Torch DS		Buctril M Pardner Torch Torch DS	Avenge 200@ Carbyne 2EC@ Hoe-Grass 284@ Mataven@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS
...seedling ...d only)*	2,4-D MCPA	2,4-D*	2,4-D		2,4-D	2,4-D MCPA		2,4-D	2,4-D (seedling control only) MCPA*	2,4-D MCPA
	Buctril M Pardner Torch Torch DS		Buctril M Pardner Torch Torch DS	Avenge 200@ Carbyne 2EC@ Hoe-Grass 284@ Mataven@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS
...seedling ...d only)*	2,4-D	2,4-D*	2,4-D		2,4-D	2,4-D		2,4-D	2,4-D (seedling control only)	2,4-D
	Buctril M Pardner Torch Torch DS		Buctril M Pardner Torch Torch DS	Hoegrass 284@ Mataven@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS
...seedling ...d only)*	2,4-D	2,4-D*	2,4-D		2,4-D	2,4-D		2,4-D	2,4-D (seedling control only)	2,4-D
	Buctril M Pardner Torch Torch DS		Buctril M Pardner Torch Torch DS	Avenge 200@ Carbyne 2EC@ Hoe-Grass 284@ Mataven@	Buctril M Pardner Torch Torch DS	Buctril M	Banvel@ Buctril M Pardner Torch Torch DS	Banvel* @ Buctril M*		Buctril M Pardner Torch Torch DS
...seedling ...d only)*	2,4-D	2,4-D*	2,4-D		2,4-D	2,4-D	Banvel@	Banvel* @ 2,4-D	2,4-D (seedling control only)	2,4-D
	Buctril M Pardner Torch Torch DS		Buctril M Pardner Torch Torch DS	Avenge 200@ Carbyne 2EC@ Hoe-Grass 284@ Mataven@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS
...seedling ...d only)*	2,4-D	2,4-D*	2,4-D	Carbyne 2EC	2,4-D	2,4-D		2,4-D	2,4-D (seedling control only)	2,4-D
	Buctril M Pardner Torch Torch DS		Buctril M Pardner Torch Torch DS	Avenge 200C@ Carbyne 2EC@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS
	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Embutox E* Tropotox Plus*	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus		Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus		Cobutox 2,4-D But Embutox Tropotox
...@	Cobutox 400 MCPA 2,4-D 2,4-D Butyric 400 Embutox E	2,4-D* MCPA*	Cobutox 400 MCPA 2,4-D Tropotox 2,4-D Plus Butyric 400 Embutox E		Cobutox 400 MCPA 2,4-D Tropotox 2,4-D Plus Butyric 400 Embutox E	Cobutox 400 MCPA 2,4-D Tropotox 2,4-D Plus Butyric 400 Embutox E	Banvel Cobutox 400 MCPA 2,4-D Tropotox 2,4-D Plus Butyric 400 Embutox E	Banvel Cobutox 400 Embutox E 2,4-D MCPA* 2,4-D Tropotox Butyric 400 Plus	Banvel@ 2,4-D* MCPA*	Cobutox 2,4-D 2,4-D Butyric Embutox

MUSTARDS	OATS (Wild)	PIGWEED (Prostrate, Redroot Tumble)	SHEPHERD'S PURSE	SMARTWEEDS	SOW-THISTLE (Annual, Perennial)	SPURGE (Leafy)	STINKWEED	THISTLE (Canada)	TOADFLAX
Asulox F*@ Cobutox 400 2,4-D Butyric 400 Embutox E	Asulox F@ Fusilade@ Avadex BW@ Hoe-Grass 284@ Avenge 200C@ 284@ Carbyne 2EC@ Kerb Eptam (ppi) Matavan@	Cobutox 400 2,4-D Butyric 400 Embutox E Eptam (ppi)	Cobutox 400 2,4-D Butyric 400 Embutox E	Asulox F@ Cobutox 400 2,4-D Butyric 400 Embutox E	Amitrol T (spot)@ Cobutox 400*	Amitrol T (spot)@	Asulox F*@ Cobutox 400 2,4-D Butyric 400 Embutox E	Amitrol T (spot)@ Cobutox 400* 2,4-D Butyric 400* Embutox E*	Amitrol T (spot)@
Asulox F@ Sinbar Princep Regione!! Kerb Sencor (m	Asulox F@ Sinbar Fusilade@ Regione!! Kerb Princep	Regione!! Sencor (m Sinbar	Regione!! Sinbar	Asulox F Sinbar Princep Regione!! Sencor (m	Amitrol T (spot)@ Regione!! Sinbar (annual)	Amitrol T (spot)@ Regione!!	Asulox F Sinbar Princep Regione!! Sencor (m	Amitrol T (spot)@ Regione	Amitrol T (spot)@ Regione!!
Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Avadex BW@ Carbyne 2EC@	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Amitrol T (spot)@ Cobutox 400* Embutox E Tropotox Plus	Amitrol T (spot)@	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Amitrol T (spot)@ Cobutox 400* 2,4-D Butyric 400* Embutox E* Tropotox Plus	Amitrol T (spot)@
	Carbyne 2EC@				Amitrol T (spot)@	Amitrol T (spot)@		Amitrol T (spot)	Amitrol T (spot)@
Tropotox Plus	Avadex BW@ Avenge 200C@ Carbyne 2EC@ Fusilade@ Hoe Grass 284@ Matavan@	Tropotox Plus	Tropotox Plus	Tropotox Plus	Amitrol T (spot)@ Tropotox Plus	Amitrol T (spot)@	Tropotox Plus	Amitrol T (spot)@ Tropotox Plus	Amitrol T (spot)@
Regione!!	Fusilade@ Regione!!	Regione!!	Regione!!	Regione!!	Amitrol T (spot)@ Regione!!	Amitrol T (spot)@ Regione!!	Regione	Amitrol T (spot)@ Regione	Amitrol T (spot)@ Regione!!
Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Avadex BW@	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Amitrol T (spot)@ Cobutox 400* Embutox E Tropotox Plus	Amitrol T (spot)@	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Amitrol T (spot)@ Cobutox 400* 2,4-D Butyric 400* Embutox E* Tropotox Plus	Amitrol T (spot)@
Regione!!	Regione!!	Regione!!	Regione!!	Regione!!	Amitrol T (spot)@ Regione!!	Amitrol T (spot)@ Regione!!	Regione	Amitrol T (spot)@ Regione	Amitrol T (spot)@ Regione!!
	Avadex BW@ Avenge 200C@ Carbyne 2EC@ Hoe Grass 284@				Amitrol T (spot)@	Amitrol T (spot)@		Amitrol T (spot)@	Amitrol T (spot)@
	Carbyne 2EC@				Amitrol T (spot)@	Amitrol T (spot)@		Amitrol T (spot)@	Amitrol T (spot)@
Cobutox 400 2,4-D Butyric 400 Embutox E	Avadex BW@ Avenge 200C@ Eptam (ppi) Fusilade@ Kerb Matavan@	Cobutox 400 2,4-D Butyric 400 Embutox E Eptam (ppi)	Cobutox 400 2,4-D Butyric 400 Embutox E	Cobutox 400 2,4-D Butyric 400 Embutox E	Amitrol T (spot)@ Cobutox 400* Embutox E	Amitrol T (spot)@	Cobutox 400 2,4-D Butyric 400 Embutox E	Amitrol T (spot)@ Cobutox 400* 2,4-D Butyric 400* Embutox E*	Amitrol T (spot)@
Princep Regione!!	Fusilade@ Kerb Princep Regione!!	Princep Regione!!	Princep Regione!!	Princep Regione!!	Amitrol T (spot)@ Regione!!	Amitrol T (spot)@ Regione!!	Princep Regione!!	Amitrol T (spot)@ Regione!!	Amitrol T (spot)@ Regione!!
	Matavan@				Amitrol T (spot)@	Amitrol T (spot)@		Amitrol T (spot)@	Amitrol T (spot)@
					Amitrol T (spot)@	Amitrol T (spot)@		Amitrol T (spot)@	Amitrol T (spot)@
Buctril M Pardner Torch Torch DS	Avenge 200@ Carbyne 2EC@ Hoe-Grass 284@ Matavan@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS	Buctril M*	
2,4-D		2,4-D	2,4-D MCPA		2,4-D	2,4-D (seedling control only) MCPA*	2,4-D MCPA	2,4-D* MCPA	2,4-D* (high rate)
Buctril M Pardner Torch Torch DS	Avenge 200@ Carbyne 2EC@ Hoe-Grass 284@ Matavan@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS	Buctril M*	
2,4-D		2,4-D	2,4-D		2,4-D	2,4-D (seedling control only)	2,4-D	2,4-D*	2,4-D* (high rate)
Buctril M Pardner Torch Torch DS	Hoegrass 284@ Matavan@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS	Buctril M*	
2,4-D		2,4-D	2,4-D		2,4-D	2,4-D (seedling control only)	2,4-D	2,4-D*	2,4-D* (high rate)
Buctril M Pardner Torch Torch DS	Avenge 200@ Carbyne 2EC@ Hoe-Grass 284@ Matavan@	Buctril M Pardner Torch Torch DS	Buctril M	Banvel@ Buctril M Pardner Torch Torch DS	Banvel* @ Buctril M*		Buctril M Pardner Torch Torch DS	Banvel@ Buctril M*	
2,4-D		2,4-D	2,4-D	Banvel@	Banvel@ 2,4-D	2,4-D (seedling control only)	2,4-D	Banvel@ 2,4-D*	2,4-D* (high rate)
Buctril M Pardner Torch Torch DS	Avenge 200@ Carbyne 2EC@ Hoe-Grass 284@ Matavan@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS	Buctril M*	
2,4-D	Carbyne 2EC@	2,4-D	2,4-D		2,4-D	2,4-D (seedling control only)	2,4-D	2,4-D*	2,4-D* (high rate)
Buctril M Pardner Torch Torch DS	Avenge 200C@ Carbyne 2EC@	Buctril M Pardner Torch Torch DS	Buctril M	Buctril M Pardner Torch Torch DS	Buctril M*		Buctril M Pardner Torch Torch DS	Buctril M*	
								2,4-D*	
Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus		Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus		Cobutox 400 2,4-D Butyric 400 Embutox E Tropotox Plus	Cobutox 400* 2,4-D Butyric 400* Embutox E* Tropotox Plus	
Cobutox 400 MCPA 2,4-D Tropotox 2,4-D Plus Butyric 400 Embutox E		Cobutox 400 MCPA 2,4-D Tropotox 2,4-D Plus Butyric 400 Embutox E	Cobutox 400 MCPA 2,4-D Tropotox 2,4-D Plus Butyric 400 Embutox E	Banvel MCPA Cobutox 400 Tropotox 2,4-D Plus Butyric 400 Embutox E	Banvel Embutox E Cobutox 400 MCPA* 2,4-D Tropotox 2,4-D Plus Butyric 400	Banvel@ 2,4-D* MCPA*	Cobutox 400 MCPA* 2,4-D Tropotox 2,4-D Plus Butyric 400 Embutox E	Banvel Embutox E* Tropotox 400 MCPA* 2,4-D 2,4-D Butyric 400	

HERBICIDE SELECTOR CHART — OTHER CROPS

* Suppression only
( ) Weeds contained or suppressed based on preliminary research
@ Grazing or feeding restrictions
# Pre-crop emergence for weed seedlings used as a crop desiccant

	BUCKWHEAT (Tartary)	BUCKWHEAT (Wild)	CHICKWEED	COCKLEBUR	COCKLE (Cow)	DARNEL (Persian)	FOXTAIL (Green)	GOOSEFOOT	GRASS (Barnyard)
BEANS (Snap and Dry) * Check label for weeds controlled, suppressed, registered for use in crop		Gramoxone# Rival Treflan	Amiben Basagran @ Eptam Gramoxone# Patoran Rival Treflan	**Basagran@ Gramoxone#**	Gramoxone# Rival Treflan	Gramoxone# Hoe Grass 284 Rival Treflan	Amiben Du- Eptam **Hoe-Grass 284** **Gramoxone#** **Patoran** **Rival** **Treflan**	Gramoxone#	Amiben Dual Eptam Gramoxone# Hoe Grass 284 Patoran Rival Treflan
CANARY GRASS	**Banvel** **Bromox 720** **Buctril M** **Pardner** **Sabre** **Torch DS**	Banvel Bromox 720 Buctril M Pardner Sabre Torch Torch DS	Bromox 720	**Buctril M**	Banvel Torch Brominal M Torch DS **Bromox 720** Buctril M Pardner Sabre				
CARROTS AND PARSNIPS (C carrots)	**Lorox L (c)**	Afolan F Lorox L (c) Rival (c) Treflan (c)	Afolan F Amiben (c) Lorox L (c) Rival (c) Treflan (c)		Afolan F Lorox L (c) Rival (c)	Rival (c) Treflan (c)	**Afolan F@** **Amiben (c)** **Lorox L (c)*** **Rival (c)** **Treflan (c)**	Afolan F @ Lorox L (c)	Afolan F Amiben (c) Lorox L (c) Rival (c) Treflan (c)
CORN * Check label for weeds controlled, suppressed, registered for use in crop FC (Field Corn)	**Banvel** **Kil-Mor** **Pardner** **Torch DS**	Afolan F Atrazine Banvel Bladex Buctril M Cobutox 4(4) F Embutox E (FC) Kil-Mor Lorox L Pardner Primextra Princep Simadex Torch DS	Afolan F Eradicane 8-E Laddok Lorox L (C) Princep Simadex	**Basagran@** **Buctril M** **2,4-D Amine** **Embutox E (FC)** **Kil-Mor** **Laddok** **Pardner**	Afolan F Banvel Buctril M Kil-Mor Lorox L Pardner Torch Torch DS		**Afolan F** **Atrazine** **Bladex** **Dual & Mixes** **Eradicane 8-E** **Lorox L** **Primextra** **Princep** **Simadex**	Afolan F @ 2,4 D Amine	Afolan F Atrazine Bladex Dual & Mixes Eradicane Lorox L Primextra Princep Simadex
FABABEANS	**Sencor**	Rival Treflan	Basagran @ Lexone Rival Sencor Treflan	**Basagran@**	Rival Treflan	Hoe Grass 284 Rival Treflan	**Hoe-Grass 284** **Rival** **Treflan**		Hoe Grass 284 Rival Treflan
LENTILS	**Sencor**	Rival Treflan	Rival Sencor Treflan		Rival Treflan	Hoe Grass 284 Rival Treflan	**Hoe-Grass 284** **Rival** **Treflan**		Hoe Grass 284 Rival Treflan
PEAS (Field and Processing) * Check label for weeds controlled, suppressed, registered for use in crop	**Lexone** **MCPA* Amine & Salts** **Regione!!** **Sencor**	MCPA* Amine & Salts Regione!! Rival Treflan	Basagran @ Lexone Phenoxylene Plus Regione!! Rival Sencor Treflan	**Basagran@** **MCPA* Amine & Salts** **Phenoxylene Plus** **Regione!!** **Tropotox***	Regione!! Rival Treflan	Bastapon @ Dalapon @ Hoe Grass 284 Regione!! Rival Treflan	**Bastapon@** **Dalapon@** **Hoe-Grass 284** **Regione!!** **Rival** **Sodium TCA (field)** **Treflan**	MCPA* Amine & Salts Regione!!	Bastapon @ Dalapon @ Hoe-Grass 284 Regione!! Sodium TCA (field) Rival Treflan
POTATOES WP (White Potatoes) TS (Table Stock Only)	**Gramoxone#** **Regione!!** **Sencor**	Afolan F Gramoxone# Lorox L Regione!! Sencor*	Afolan F Eptam Gramoxone# Lexone Lorox L Patoran Phenoxylene Plus TS@ Regione Sencor	**Gramoxone#** **Phenoxylene Plus (TS)@** **Regione!!**	Gramoxone# Lorox L Regione!!	Bastapon Fusilade Gramoxone# Hoe Grass 284 Regione!!	**Afolan F** **Bastapon@** **Dual** **Eptam** **Fusilade** **Gramoxone#** **Hoe-Grass 284** **Lexone*** **Lorox L** **Patoran** **Regione!!** **Sencor***	Afolan F Gramoxone# Lorox L Regione!!	Afolan F @ Bastapon @ Dual Eptam Fusilade Gramoxone# Hoe Grass 284 Lorox L Patoran Regione!! Sencor
RUTABAGAS		Rival Treflan	Eptam Rival Treflan		Rival Treflan	Rival Treflan	**Eptam** **Rival** **Treflan**		Eptam Rival Treflan
SOYBEANS	**Regione!!**	Regione!! Rival Treflan	Basagran @ Patoran Regione!! Rival Treflan	**Basagran@** **Regione!!**	Regione!! Rival Treflan	Hoe Grass 284 Poast Regione!! Rival Treflan	**Hoe-Grass 284** **Patoran** **Poast** **Regione!!** **Rival** **Treflan**	Regione!!	Hoe Grass 284 Patoran Poast Regione!! Rival Treflan
SUNFLOWERS	**Regione!!**	Regione!! Rival Treflan	Amiben & Treflan Eptam Regione!! Rival Treflan	**Regione!!**	Regione!! Rival Treflan	Fusilade Hoe-Grass 284 Poast Regione!! Rival Treflan	**Amiben & Treflan** **Eptam** **Fusilade** **Hoe-Grass 284** **Poast** **Regione!!** **Rival** **Treflan**	Regione!!	Amiben & Treflan* Eptam Fusilade Hoe-Grass 284 Poast Regione!! Rival Treflan
TAME BUCKWHEAT						Basafapon Hoe-Grass 284	**Bastapon** **Hoe-Grass 284**		Bastapon Hoe-Grass 284
TRITICALE	**Hoe-Grass II** **Pardner** **Torch DS**	Hoe-Grass II Pardner Torch DS			Hoe-Grass II Pardner Torch DS	Hoe-Grass II Hoe-Grass 284	**Hoe-Grass II** **Hoe-Grass 284**		Hoe-Grass II Hoe-Grass 284

PS

GRASS (Barnyard)	GROUNDSEL (Common)	HEMP-NETTLE	KNOTWEED	KOCHIA	LAMB'S-QUARTERS	MUSTARDS	NIGHTSHADE	OATS (Wild)	PIGWEED (Prostrate)	PIGWEED (Redroot)
[illegible]	**Basagran** **Gramoxone#** **Patoran**	Gramoxone#	Gramoxone# Rival Treflan	**Gramoxone#**	Amiben Basagran @ Eptam Gramoxone# Patoran Rival Treflan	Amiben Basagran @ Gramoxone# Patoran	**Basagran@** **Eptam** **Gramoxone#**	Eptam Hoe Grass 284 Gramoxone# Rival Treflan	Amiben Eptam Gramoxone# Patoran Rival Treflan	**Amiben** **Basagran@** **Eptam** **Gramoxone#** **Patoran** **Rival** **Treflan**
	Bromox 720 **Buctril M** **Pardner** **Sabre** **Torch DS**	Buctril M & MCPA		**Bromox 720** **Pardner** **Sabre** **Torch DS**	Bromox 720 Buctril M Pardner Sabre Torch DS	Bromox 720 Buctril M Pardner Sabre Torch DS		Avenge Mataven		**Bromox 720** **Buctril M** **Pardner** **Sabre** **Torch DS**
[illegible] F [illegible] (C) [illegible] L (C) [illegible] (C) [illegible] (C)	**Afolan F** **Lorox L (c)**		Afolan F @ Lorox L (c) Rival (c) Treflan (c)	**Afolan F@** **Lorox L (C)**	Afolan F @ Amiben (c) Lorox L (c) Rival (c) Treflan (c)	Afolan F @ Lorox L (c)		Rival (c) Treflan (c)	Afolan F @ Amiben (c) Lorox L (c) Rival (c) Treflan (c)	**Afolan F@** **Amiben (c)** **Lorox L (c)** **Rival (c)** **Treflan (c)**
[illegible] F [illegible]zine [illegible]dex [illegible]er & Mixes [illegible]dicane [illegible] L [illegible]mextra [illegible]ncep [illegible]adex	**Afolan F@** **Basagran @** **Buctril M** **Laddok** **Lorox L** **Pardner** **Torch DS**	Buctril M Tropotox Plus (FC)	Afolan F @ Bladex Kil-Mor Lorox L Tropotox Plus (FC)	**Afolan F@** **Buctril M** **2,4-D Amine & Ester.** **Lorox L** **Pardner** **Torch DS**	Afolan F @ Atrazine Basagran @ Bladex Basagran @ 2,4-D Amine & ester Embutox E (FC) Eradicane 8 E Cobutox 400 (FC) Kil-Mor Laddok Lorox L Pardner Primextra Princep Simadex Torch DS Tropotox Plus (FC)	Afolan F Atrazine Basagran @ Bladex Buctril M Cobutox 400 (FC) 2,4-D Amine & ester Embutox E (FC) Kil-Mor Laddok Lorox L Pardner Primextra Torch DS Tropotox Plus (FC)	**Atrazine** **Basagran** **Bladex** **Eradicane** **Laddok**	Atrazine Eradicane 8 E Princep Simadex	Afolan F Atrazine Bladex 2,4-D Amine Eradicane 8 E Kil-Mor Lorox L Primextra	**Afolan F** **Atrazine** **Bladex** **Basagran @** **Buctril M** **Cobutox 400 (** **2,4-D Amine** **Embutox E (F** **Eradicane 8 E** **Kil-Mor** **Laddok** **Lorox L** **Pardner** **Primextra** **Torch DS** **Tropotox Plus**
[illegible] Grass 284 [illegible]	**Basagran@** **Sencor**	Lexone Sencor	Rival Treflan		Basagran @ Lexone Rival Sencor Treflan	Basagran @ Lexone Sencor	**Basagran@**	Carbyne 2EC Hoe Grass 284 Rival Treflan	Rival Treflan	**Basagran@** **Lexone** **Rival** **Sencor** **Treflan**
[illegible] Grass 284 [illegible]	**Sencor**	Sencor	Rival Treflan		Rival Sencor Treflan	Sencor		Carbyne 2EC Hoe Grass 284 Rival Treflan	Rival Treflan	**Rival** **Sencor** **Treflan**
[illegible] @ [illegible] [illegible] Grass 284 [illegible] [illegible] 2,4-D Amine [illegible]	**Basagran@** **Regione!!** **Sencor**	Lexone MCPA* Amine & Salts Regione!! Sencor Tropotox Tropotox Plus	Regione!! Rival Treflan Tropotox Plus	**Phenoxylene Plus** **Regione!!**	Basagran @ Lexone MCPA* Amine & Salts Phenoxylene Plus Regione!! Rival Sencor Treflan Tropotox Tropotox Plus	Basagran @ Lexone MCPA* Amine & Salts Phenoxylene Plus Regione!! Sencor Tropotox Tropotox Plus	**Basagran@** **Regione!!**	AvaJex BW Basfapon Carbyne Dalapon Hoe Grass 284 Regione!! Rival Treflan	MCPA* Amine & Salts*! Regione!! Rival Treflan	**Basagran** **MCPA* Amin** **Phenoxylene** **Regione!!** **Rival** **Sencor** **Treflan** **Tropotox** **Tropotox Plus**
[illegible] F [illegible] [illegible] [illegible] [illegible] [illegible] Grass 284 [illegible] [illegible]	**Afolan F** **Gramoxone#** **Lorox L** **Patoran** **Regione!!** **Sencor**	Gramoxone# Lexone Lorox L Regione!! Sencor	Afolan F @ Gramoxone# Lorox L Regione!!	**Afolan F@** **Gramoxone#** **Lexone#** **Lorox L** **Patoran#** **Phenoxylene Plus (TS)#** **Regione!!** **Sencor#**	Afolan F Eptam Gramoxone# Lexone Lorox L Patoran Phenoxylene Plus (TS)# Regione Sencor	Afolan F Gramoxone# Lexone# Lorox L Patoran Phenoxylene Plus Regione!! Sencor	**Eptam** **Gramoxone#** **Regione!!**	Basfapon Eptam Fusilade Gramoxone# Hoe Grass 284 Regione!!	Afolan F Eptam Gramoxone# Lexone Lorox L Patoran Regione!! Sencor	**Afolan F** **Eptam** **Gramoxone#** **Lexone** **Lorox L** **Patoran** **Phenoxylene P** **Regione!!** **Sencor**
[illegible] [illegible]			Rival Treflan		Eptam Rival Treflan		**Eptam**	Eptam Rival Treflan	Eptam Rival Treflan	**Eptam** **Rival** **Treflan**
[illegible] Grass 284 [illegible] [illegible] [illegible]	**Basagran@** **Patoran** **Regione!!**	Regione!!	Regione!! Rival Treflan	**Patoran** **Regione!!**	Basagran @ Patoran Regione!! Rival Treflan	Basagran Patoran Regione!!	**Basagran@** **Regione!!**	Hoe Grass 284 Poast Regione!! Rival Treflan	Patoran Regione!! Rival Treflan	**Basagran@** **Patoran** **Regione!!** **Rival** **Treflan**
[illegible] & Treflan* [illegible] [illegible]ade [illegible] Grass 284 [illegible] [illegible] [illegible]	**Regione!!**	Amiben & Treflan Regione!!	Regione!! Rival Treflan	**Regione!!**	Amiben & Treflan Eptam Regione!! Rival Treflan	Amiben & Treflan Regione!!	**Eptam** **Regione!!**	Amiben & Treflan Carbyne 2EC Eptam Fusilade Hoe Grass 284 Poast Regione! Rival Treflan	Amiben & Treflan Eptam Regione!! Rival Treflan	**Amiben & Tre** **Eptam** **Regione!!** **Rival** **Treflan**
[illegible]dapon [illegible] Grass 284								Hoe Grass 284		
[illegible] Grass II [illegible] Grass 284	**Hoe-Grass II** **Pardner** **Torch DS**			**Hoe-Grass II** **Pardner** **Torch DS**	Hoe Grass II Pardner Torch DS	Pardner Torch DS		Hoe-Grass II Hoe Grass 284 Mataven		**Hoe-Grass II** **Pardner** **Torch DS**

PIGWEED (Prostrate)	PIGWEED (Redroot)	PURSLANE	RADISH (Wild)	RAPESEED (Volunteer)	SMARTWEEDS	SOW-THISTLE (Annual, Perennial)	SPURRY (Corn)	STINKWEED	THISTLE (Canada)	
Amiben Eptam Gramoxone# Patoran Rival Treflan	**Amiben** **Basagran@** **Eptam** **Gramoxone#** **Patoran** **Rival** **Treflan**	Basagran@ Eptam Gramoxone# Patoran Rival Treflan	Basagran*@ Gramoxone#	**Basagran*@** **Gramoxone#**	Amiben Basagran@ Patoran	Gramoxone#	**Basagran@** **Eptam** **Gramoxone#** **Patoran**	Amiben Basagran@ Gramoxone# Patoran	Basagran@ Gramoxone#	**Basag** **Gramo** **Rival** **Treflan**
	Bromox 720 **Buctril M** **Pardner** **Sabre** **Torch DS**				Banvel Buctril M Pardner Sabre Torch DS	Banvel* Bromox 720 (P) Buctril M* (P) Sabre* (P)	**Banvel**	Bromox 720 Buctril M Pardner Sabre Torch DS	Banvel* Bromox 720* Buctril M* Sabre*	**Bromox** **Pardner** **Sabre** **Torch D**
Afolan F@ Amiben (c) Lorox L (c) Rival (c) Treflan (c)	**Afolan F@** **Amiben (c)** **Lorox L (c)** **Rival (c)** **Treflan (c)**	Afolan F@ Lorox L (c) Rival (c) Treflan (c)	Afolan F@ Lorox L (c)		Afolan F Amiben (c) Lorox L (c)	Afolan F (seeding) Lorox L (c)(A)	**Afolan F** **Lorox L (c)** **Treflan (c)**	Afolan F Lorox L (c)	Lorox L (c)*	**Rival (c)** **Treflan**
Afolan F Atrazine Bladex 2,4-D Amine Eradicane 6-E Kil-Mor Laddok Lorox L Pardner Primextra Torch DS Tropotox Plus (FC)	**Afolan F** **Atrazine** **Bladex** **Basagran@** **Buctril M** **Cobutox 400 (FC)** **2,4-D Amine@** **Embutox E (FC)** **Eradicane 6-E** **Kil-Mor** **Laddok** **Lorox L** **Pardner** **Primextra** **Torch DS** **Tropotox Plus (FC)**	Afolan F Atrazine Basagran@ Bladex 2,4-D Amine Eradicane 6-E Laddok Lorox L Primextra Princep Simadex Tropotox Plus (FC)	Afolan F@ Basagran@ 2,4-D Amine Lorox L	**Basagran*@** **2,4-D Amine* & Salts**** **Although not registered for this use, those products registered to control mustards might be expected to safely control volunteer rapeseed.**	Afolan F Atrazine Banvel Basagran@ Bladex Buctril M Cobutox 400* (FC) Embutox E (FC) Kil-Mor Laddok Lorox L Pardner Primextra Princep Simadex Torch DS Tropotox Plus (FC)	Afolan F@ Amitrol T (spot) Banvel & Mixes Buctril M*(P) 2,4-D Amine Embutox E (FC) Kil-Mor Lorox L (A) Tropotox Plus (FC)	**Afolan F@** **Banvel** **Basagran@** **Eradicane 6-E** **Kil-Mor** **Laddok** **Lorox L**	Afolan F@ Basagran@ Buctril M Cobutox 400* (FC) 2,4-D Amine Embutox E (FC) Kil-Mor Lorox L Pardner Princep Simadex Torch DS Tropotox Plus (FC)	Amitrol T (spot) Banvel* Basagran@ Buctril M* 2,4-D* Embutox E (FC) Kil-Mor Lorox L* Tropotox Plus (FC)	**Basagr** **Buctril** **2,4-D Ar** **Kil-Mor** **Laddok** **Pardner** **Torch** **Torch D**
	Basagran@ **Lexone** **Rival** **Sencor** **Treflan**	Basagran@ Rival Treflan	Basagran@	**Basagran*@** **Lexone** **Sencor**	Basagran@ Lexone Sencor		**Basagran@** **Lexone** **Sencor**	Basagran@ Lexone Sencor	Basagran@	**Basagra** **Rival** **Sencor** **Treflan**
	Rival **Sencor** **Treflan**	Rival Treflan		**Sencor**	Sencor		**Sencor**	Sencor		**Rival** **Sencor** **Treflan**
MCPA* Amine & Salts Phenoxylene Plus Regione!! Rival Sencor Treflan Tropotox Tropotox Plus	**Basagran** **MCPA* Amine & Salts** **Phenoxylene Plus** **Regione!!** **Rival** **Sencor** **Treflan** **Tropotox** **Tropotox Plus**	Basagran@ MCPA* Amine & Salts Regione!! Rival Treflan Tropotox Tropotox Plus	Basagran*@ MCPA* Amine & Salts Regione!!	**Basagran*@** **Lexone** **MCPA* Amine & Salts** **Regione!!** **Sencor**	Basagran@ Lexone MCPA* Amine & Salts Phenoxylene Plus Regione!! Sencor Tropotox Tropotox Plus	Amitrol T (spot) MCPA* Amine & Salts Phenoxylene Plus (annual) Regione!! Tropotox Tropotox Plus	**Basagran** **Lexone** **Regione!!** **Sencor**	Basagran@ Lexone MCPA* Amine & Salts Phenoxylene Plus Regione!! Sencor Tropotox Tropotox Plus	Amitrol T (spot) Basagran@ MCPA* Amine & Salts Regione!! Tropotox Tropotox Plus	**Basagra** **Regione!** **Rival** **Sencor** **Treflan**
Afolan F Eptam Gramoxone# Lexone Lorox L Patoran Phenoxylene Plus (TS)# Regione!! Sencor	Afolan F Eptam Gramoxone# Lexone Lorox L Patoran Phenoxylene Plus (TS)# Regione!! Sencor	Afolan F Eptam Gramoxone# Lorox L Patoran Regione!!	Afolan F Gramoxone# Lorox L Regione!!	**Gramoxone#** **Lexone** **Regione!!** **Sencor**	Afolan F Gramoxone# Lexone Lorox L Patoran Phenoxylene Plus (TS)# Regione!! Sencor	Afolan F (seeding) Gramoxone# Lorox L (A) Phenoxylene Plus (annual) Regione!!	**Afolan F** **Eptam** **Gramoxone#** **Lexone** **Lorox L** **Patoran** **Regione!!** **Sencor**	Afolan F Gramoxone# Lexone Lorox L Patoran Phenoxylene Plus (TS)# Regione!! Sencor	Gramoxone# Lorox L* Regione!!	**Gramoxo** **Lexone** **Regione!!** **Sencor**
	Eptam Rival Treflan	Eptam Rival Treflan					Eptam			**Rival** **Treflan**
Afolan F Basagran@ Patoran Rival Treflan	**Basagran@** **Patoran** **Regione!!** **Rival** **Treflan**	Basagran Patoran Regione!! Rival Treflan	Basagran*@ Regione!!	**Basagran*** **Regione!!**	Basagran@ Patoran Regione!!	Amitrol T (spot) Regione!!	**Basagran@** **Patoran** **Regione!!**	Basagran* Patoran Regione!!	Amitrol T (spot) Basagran@ Regione!!	**Basagran** **Regione!!** **Rival** **Treflan**
Amiben & Treflan Eptam Regione!! Rival Treflan	**Amiben & Treflan** **Eptam** **Regione!!** **Rival** **Treflan**	Eptam Regione!! Rival Treflan	Regione!!	**Regione!!**	Amiben & Treflan Regione!!	Regione!!	**Eptam** **Regione!!**	Amiben & Treflan Regione!!	Regione!!	**Regione!!** **Rival** **Treflan**
	Hoe-Grass II **Pardner** **Torch DS**				Hoe-Grass II Pardner Torch DS			Hoe-Grass II Pardner Torch DS		**Hoe-Grass I** **Pardner** **Torch DS**

RADISH (Wild)	RAPESEED (Volunteer)	SMARTWEEDS	SOW-THISTLE (Annual, Perennial)	SPURRY (Corn)	STINKWEED	THISTLE (Canada)	THISTLE (Russian)	VOLUNTEER CEREALS	
Basagran*@ Gramoxone#	**Basagran*@ Gramoxone#**	Amiben Basagran@ Patoran	Gramoxone#	**Basagran@ Eptam Gramoxone# Patoran**	Amiben Basagran@ Gramoxone# Patoran	Basagran@ Gramoxone#	**Basagran@ Gramoxone# Rival Treflan**	Eptam Gramoxone# Treflan*	
		Banvel Buctril M Pardner Sabre Torch DS	Banvel* Bromox 720 (P) Buctril M* (P) Sabre* (P)	**Banvel**	Bromox 720 Buctril M Pardner Sabre Torch DS	Banvel* Bromox 720* Buctril M* Sabre*	**Bromox 720 Pardner Sabre Torch DS**		
Afolan F@ Lorox L (c)		Afolan F Amiben (c) Lorox L (c)	Afolan F (seedling) Lorox L (c)(A)	**Afolan F Lorox L (c) Treflan (c)**	Afolan F Lorox L (c)	Lorox L (c)*	**Rival (c) Treflan (c)**		
Afolan F@ Basagran@ 2,4-D Amine Lorox L	**Basagran*@ 2,4-D Amine* & Salts** Although not registered for this use, those products registered to control mustards might be expected to safely control volunteer rapeseed.	Afolan F@ Atrazine Banvel Basagran@ Bladex Buctril M Cobutox 400* (FC) Embutox E (FC) Kil-Mor Laddok Lorox L Pardner Primextra Princep Simadex Torch DS Tropotox Plus (FC)	Afolan F@ Amitrol T (spot) Banvel & Mixes Buctril M*(P) 2,4-D Amine Embutox E (FC) Kil-Mor Lorox L (A) Tropotox Plus (FC)	**Afolan F@ Banvel Basagran@ Eradicane 8-E Kil-Mor Laddok Lorox L**	Afolan F@ Basagran@ Buctril M Cobutox 400* (FC) 2,4-D Amine Embutox E (FC) Kil-Mor Lorox L Pardner Princep Simadex Torch DS Tropotox Plus (FC)	Amitrol T (spot) Banvel* Basagran@ Buctril M* 2,4-D* Embutox E (FC) Kil-Mor Lorox L* Tropotox Plus (FC)	**Basagran@ Buctril M 2,4-D Amine Kil-Mor Laddok Pardner Torch Torch DS**	Atrazine Eradicane 8-E	
Basagran*@	**Basagran*@ Lexone Sencor**	Basagran@ Lexone Sencor		**Basagran@ Lexone Sencor**	Basagran@ Lexone Sencor	Basagran@	**Basagran@ Rival Sencor Treflan**	Treflan*	
	Sencor	Sencor		Sencor	Sencor		Rival Sencor Treflan		
Basagran*@ MCPA* Amine & Salts Regione!!	**Basagran*@ Lexone MCPA* Amine & Salts Regione!! Sencor**	Basagran@ Lexone MCPA* Amine & Salts Phenoxylene Plus Regione!! Sencor Tropotox Tropotox Plus	Amitrol T (spot) MCPA* Amine & Salts Phenoxylene Plus (annual) Regione!! Tropotox Tropotox Plus	**Basagran Lexone Regione!! Sencor**	Basagran@ Lexone MCPA* Amine & Salts Phenoxylene Plus Regione!! Sencor Tropotox Tropotox Plus	Amitrol T (spot) Basagran@ MCPA* Amine & Salts Regione!! Tropotox Tropotox Plus	**Basagran@ Regione!! Rival Sencor Treflan**	Regione Treflan*	
Afolan F Gramoxone# Lorox L Regione!!	**Gramoxone# Lexone Regione!! Sencor**	Afolan F Gramoxone# Lexone Lorox L Patoran Phenoxylene Plus (TSI)# Regione!! Sencor	Afolan F (seeding) Gramoxone# Lorox L (A) Phenoxylene Plus (annual) Regione!!	**Afolan F Eptam Gramoxone# Lexone Lorox L Patoran Regione!! Sencor**	Afolan F Gramoxone# Lexone Lorox L Patoran Phenoxylene Plus (TSI)# Regione!! Sencor	Gramoxone# Lorox L* Regione!!	**Gramoxone# Lexone* Regione!! Sencor**	Eptam Fusilade Gramoxone# Lexone* Regione Sencor*	
				Eptam			**Rival Treflan**	Eptam	
Basagran*@ Regione!!	**Basagran* Regione!!**	Basagran@ Patoran Regione!!	Amitrol T (spot) Regione!!	**Basagran@ Patoran Regione!!**	Basagran* Patoran Regione!!	Amitrol T (spot) Basagran@ Regione!!	**Basagran Regione!! Rival Treflan**	Poast Regione Treflan*	
Regione!!	**Regione!!**	Amiben & Treflan Regione!!	Regione!!	**Eptam Regione!!**	Amiben & Treflan Regione!!	Regione!!	**Regione!! Rival Treflan**	Eptam Fusilade Regione Treflan*	
		Hoe-Grass II Pardner Torch DS			Hoe-Grass II Pardner Torch DS		**Hoe-Grass II Pardner Torch DS**		

NOTE: Insecticides Listed By Active Ingredient Trade Name

INSECTICIDE SELECTOR CHART

CROPS / INSECTS	BEETLES						
	BLISTER BEETLES	COLORADO POTATO BEETLE	FLEA BEETLES	RED TURNIP BEETLE	WEEVILS (Sweet Clover, Alfalfa)	WIREWORMS	ALFALFA LOOPER
BARLEY						Gamma BHC (Lindane)	
OATS						Gamma BHC (Lindane)	
RYE						Gamma BHC (Lindane)	
WHEAT						Gamma BHC (Lindane)	
CORN (FIELD)						Gamma BHC (Lindane)	
ALFALFA	Carbaryl (Sevin)		Methoxychlor		Azinphos-methyl (Guthion) Carbaryl (Sevin) Carbofuran (Furadan) Deltamethrin (Decis) Dimethoate (Cygon) Malathion Methidathion (Supracide) Methoxychlor		
CLOVER	Carbaryl (Sevin)		Methoxychlor		Azinphos-methyl (Guthion) Carbaryl (Sevin) Dimethoate (Cygon) Malathion Methoxychlor		
PASTURE							
CANOLA			Azinphos-methyl (Guthion) Carbaryl (Sevin) Carbofuran (Furadan) Deltamethrin (Decis) Gamma BHC (Lindane) Malathion Methidathion (Supracide) Terbufos (Counter)	Azinphos-methyl (Guthion) Carbofuran (Furadan) Methidathion (Supracide)			Chlorpyrifos (Lorsban) Methomyl (Lannate, Nudrin)
FLAX							
MUSTARD			Carbofuran (Furadan) [illegible] Gamma BHC (Lindane) Malathion Methidathion (Supracide)				
SUNFLOWER							
SUGAR BEETS			Azinphos-methyl (Guthion) Malathion			Gamma BHC (Lindane) Terbufos (Counter)	
POTATO	Methoxychlor	Aldicarb (Temik) Azinphos-methyl (Guthion) Carbaryl (Sevin) Carbofuran (Furadan) Chlorpyrifos (Lorsban) Deltamethrin (Decis) Diazinon Endosulfan (Thiodan) Malathion Methamidophos (Monitor) Methidathion (Supracide) Methoxychlor Deltamethrin (Decis) Permethrin (Ambush) Thimet (Phorate)	Aldicarb (Temik) Carbofuran (Furadan) Chlorpyrifos (Lorsban) Diazinon Endosulfan (Thiodan) Methamidophos (Monitor) Methidathion (Supracide) Methomyl (Lannate, Nudrin) Permethrin (Ambush) Methoxychlor Deltamethrin (Decis) Thimet (Phorate)			Fonofos (Dyfonate) *not included in manual Thimet (Phorate) (reduction only)	
SWEET CORN						Gamma BHC (Lindane)	

ALFALFA LOOPER	ARMYWORMS	*BERTHA ARMYWORM OR CLOVER CUTWORM	BEET WEBWORM	CUTWORMS (Army, Red-backed, Pale Western)	DIAMONDBACK MOTH LARVAE	EUROPEAN CORN BORER OR *CORN EARWORM	FLAX BOLLWORM	THISTLE B (Painted
	Azinphos-Methyl (Guthion) Carbaryl (Sevin) Chlorpyrifos (Lorsban) Malathion Methomyl (Lannate, Nudrin) Methoxychlor Trichlorfon (Dylox)			Chlorpyrifos (Lorsban) Deltamethrin (Decis) Permethrin (Ambush)				
	Azinphos-Methyl (Guthion) Carbaryl (Sevin) Chlorpyrifos (Lorsban) Malathion Methomyl (Lannate, Nudrin) Methoxychlor Trichlorfon (Dylox)			Chlorpyrifos (Lorsban) Deltamethrin (Decis) Permethrin (Ambush)				
	Azinphos-Methyl (Guthion) Carbaryl (Sevin) Chlorpyrifos (Lorsban) Malathion Trichlorfon (Dylox)			Permethrin (Ambush)				
	Azinphos-Methyl (Guthion) Carbaryl (Sevin) Chlorpyrifos (Lorsban) Malathion Methomyl (Lannate, Nudrin) Methoxychlor Trichlorfon (Dylox)			Chlorpyrifos (Lorsban) Deltamethrin (Decis) Permethrin (Ambush)				
	Carbaryl (Sevin) Methomyl (Lannate, Nudrin) Methoxychlor Trichlorfon (Dylox)			Chlorpyrifos (Lorsban) Permethrin (Ambush)		Carbaryl (Sevin) Carbofuran (Furadan) Endosulfan* (Thiodan) Malathion* *Corn Earworm Only Permethrin (Ambush)		
	Methoxychlor Trichlorfon (Dylox)		Carbaryl (Sevin) Trichlorfon (Dylox)					
	Carbaryl (Sevin) Methoxychlor		Carbaryl (Sevin)					
Chlorpyrifos (Lorsban) Methomyl (Lannate, Nudrin)	Chlorpyrifos (Lorsban)	Chlorpyrifos* (Lorsban*) Methamidophos* (Monitor*) Methomyl (Lannate, Nudrin) *Bertha Armyworm Only Deltamethrin (Decis)	Methomyl (Lannate, Nudrin) Trichlorfon (Dylox)	Chlorpyrifos (Lorsban) Permethrin (Ambush)	Azinphos-methyl (Guthion) Chlorpyrifos (Lorsban) Malathion Methidathion (Supracide) Trichlorfon (Dylox)			
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	FLIES		GRASSHOPPERS	PLANT BUGS	STORED GRAIN INSECTS	SUCKING INSECTS		
THISTLE BUTTERFLY (Painted Lady)	BEET LEAFMINER	ROOT MAGGOTS (Corn, Sugar Beet)	(Clear-winged, migratory, two-striped)	ALFALFA, SUPERB, STINK, LYGUS, TARNISHED	FLOUR BEETLES, GRAIN BEETLES, MEDITERRANEAN FLOUR MOTH	APHIDS (Corn leaf, Green bug, Green Peach, English Grain, Pea)	LEAFHOPPERS (Potato)	SPITTL
			Azinphos-methyl (Guthion) Carbaryl (Sevin) Carbofuran (Furadan) Chlorpyrifos (Lorsban) Deltamethrin (Decis) Dimethoate (Cygon) Malathion		Malathion Phosphine (Gastoxin, Phostoxin)	Dimethoate (Cygon) Malathion		
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			Carbofuran (Furadan) Deltamethrin (Decis) Malathion					
			Carbofuran (Furadan) Malathion					
Methidathion (Supracide)								
		Aldicarb (Temik) Carbofuran (Furadan) Terbufos (Counter)				Endosulfan (Thiodan)		
			Dimethoate (Cygon)	Azinphos-methyl (Guthion) Carbofuran (Furadan) Chlorpyrifos (Lorsban) Deltamethrin (Decis) Endosulfan (Thiodan) Methidathion (Supracide) Permethrin (Ambush)		Azinphos-methyl (Guthion) Aldicarb (Temik) Carbofuran (Furadan) Diazinon Dimethoate (Cygon) Endosulfan (Thiodan) Malathion Methamidophos (Monitor) Methomyl (Lannate, Nudrin) Pirimicarb (Pirimor) Thimet (Phorate)	Azinphos-methyl (Guthion) Aldicarb (Temik) Carbofuran (Furadan) Deltamethrin (Decis) Diazinon Dimethoate (Cygon) Endosulfan (Thiodan) Malathion Methamidophos (Monitor) Methomyl (Lannate, Nudrin) Methoxychlor Permethrin (Ambush) Thimet (Phorate)	Azinph (Guthio
		Diazinon	Carbaryl (Sevin) Carbofuran (Furadan) Malathion			Endosulfan (Thiodan) Malathion Pirimicarb (Pirimor)		

FLIES		GRASSHOPPERS	PLANT BUGS	STORED GRAIN INSECTS	SUCKING INSECTS			THRIPS
IINER	ROOT MAGGOTS (Corn, Sugar Beet)	(Clear-winged, migratory, two-striped)	ALFALFA, SUPERB, STINK, LYGUS, TARNISHED	FLOUR BEETLES, GRAIN BEETLES, MEDITERRANEAN FLOUR MOTH	APHIDS (Corn leaf, Green bug, Green Peach, English Grain, Pea)	LEAFHOPPERS (Potato)	SPITTLEBUGS	BARLEY, GRASS, RED CLOVER
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		Carbaryl (Sevin) Carbofuran (Furadan) Chlorpyrifos (Lorsban) Dimethoate (Cygon) Malathion Methamidophos (Monitor)			Dimethoate (Cygon)	Dimethoate (Cygon)		
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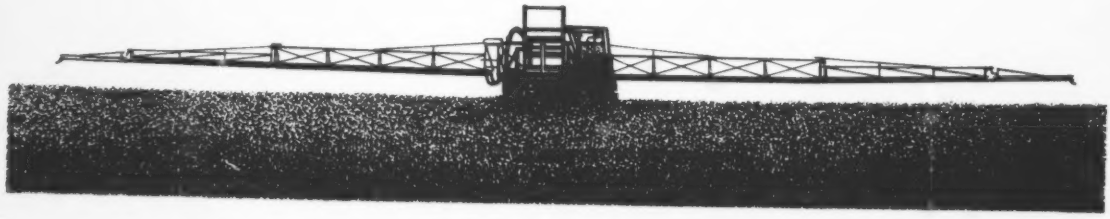

GUIDE TO CROP PROTECTION IN ALBERTA

PART III
PESTICIDE APPLICATION EQUIPMENT

Alberta
AGRICULTURE

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GUIDE TO

CROP PROTECTION

IN ALBERTA

PART III
PESTICIDE APPLICATION EQUIPMENT

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GUIDE TO CROP PROTECTION IN ALBERTA
PART III PESTICIDE APPLICATION EQUIPMENT

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PESTICIDE APPLICATION EQUIPMENT

INTRODUCTION

The use of pesticides requires that all application equipment be of the best quality available and be used correctly.

Incorrectly applied pesticides may result in waste of the pesticide, poor or no control, crop damage or environmental contamination. Every effort must be made to apply pesticides correctly to help eliminate these undesirable results.

Recent advances in equipment technology can make the job of accurate pesticide application relatively simple and precise.

This publication provides information that will aid in the selection and use of application equipment so that pesticides may be applied as accurately as current technology allows.

Since 1981 all pesticides are being supplied and labelled in metric measure. All labels are made in terms of litres of formulated product per hectare or in the case of dry materials, in kilograms of product per hectare.

Alberta Agriculture has decided to maintain land measure in ACRES. This publication lists application volumes as litres or kilograms per ACRE.

This will necessitate converting pesticide label information. The following conversion factor is supplied to assist in this conversion:

Litres or kilograms per hectare x 0.4047 = L or kg per acre.

Alberta Agriculture's "Blue Book" publication GUIDE TO CROP PROTECTION IN ALBERTA — PART I — CHEMICAL SELECTION is written using acres and is compatible for use with this publication without conversion.

SPRAY TIPS

- — Know your chemicals: read the labels carefully to determine which is the right one for your crops.
- — Know your crops: especially the stage that will tolerate the chemical you use.
- — Know your problems: make sure that the weeds and insects you have are susceptible to the chemicals you plan to use.
- — Know your timing: if it isn't right for one chemical it may be for another.
- — Be prepared to invest in quality equipment: there's no sense spraying with worn out equipment that is worth a fraction of the chemical you are using.
- — Pump output should be checked to ensure it produces the required volume for spraying and agitation of the spray solution in the tank.
- — Check pressure in the boom to ensure there is no restriction in the flow to the nozzles.
- — Ensure all nozzles on the boom are the same size and spray angle.
- — Check nozzle spray patterns. Clean or replace nozzle tips that have streaky spray patterns.
- — Check the output from all nozzles on the boom using a calibration cup or some other measuring device. Output from the nozzles should be within five per cent of each other.
- — Liquid filled pressure gauges will prevent the gauge indicator from fluttering. The gauge will be easier to read accurately and will remain accurate longer.
- — Adjust boom height in the field so that the spray pattern from one nozzle overlaps 30 per cent into the pattern of the adjacent nozzle above the target. The target is the ground for soil applied herbicides and the average weed height for post-emergent herbicides.

PROTECTIVE CLOTHING

Everyone who handles pesticides should read the label on the container very carefully, and should wear the standard protective clothing to avoid potential health hazards.

Pesticides include herbicides, insecticides and fungicides, and the standard protective clothing that is recommended is:

- — a long-sleeved shirt
- — full-length pants
- — overalls
- — unlined neoprene or rubber gloves
- — rubber boots
- — a wide-brimmed hat.

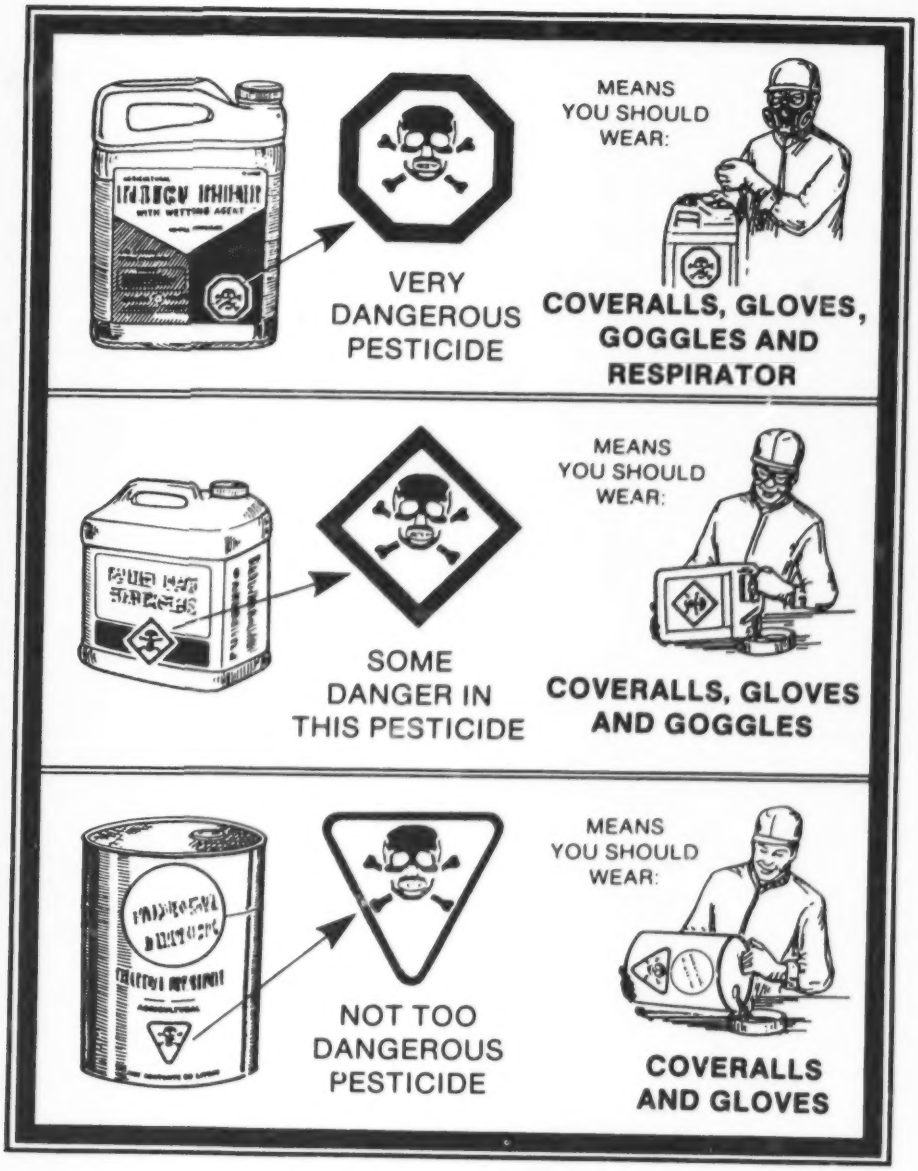
Cloth or leather gloves, leather shoes or sneakers and a baseball cap should never be substituted for the standard protective clothing listed above because they absorb chemicals and will expose the wearer to the chemicals.

In some cases, goggles and a respirator are recommended for people handling pesticides. Goggles, or a face shield, protect the eyes and the face against pesticide vapors, dust and splashes, while a respirator will prevent the inhalation of dust, powders and sprays.

A respirator covers the nose and mouth and contains a charcoal cartridge as well as a filter pad to filter out dust and spray particles. The risk of a health hazard from using pesticides will be greatly reduced if the respirator cartridge is changed after eight hours of use or when the wearer detects a chemical odor.

Anyone who has handled pesticides should shower and change clothing when the operation is finished.

The above information, plus information on laundering pesticide-contaminated clothing, is contained in a publication entitled "Protective Clothing for Use with Pesticides" (Homedex 1353-90). It can be obtained from district home economists or by writing to the Publications Office, Alberta Agriculture, J.G. O'Donoghue Building, 7000 - 113 Street, Edmonton, Alberta, T6H 5T6.


MEANS YOU SHOULD WEAR:
VERY DANGEROUS PESTICIDE
COVERALLS, GLOVES, GOGGLES AND RESPIRATOR
MEANS YOU SHOULD WEAR:
SOME DANGER IN THIS PESTICIDE
COVERALLS, GLOVES AND GOGGLES
MEANS YOU SHOULD WEAR:
NOT TOO DANGEROUS PESTICIDE
COVERALLS AND GLOVES

What the pesticide label means

SPRAYER TYPES

More pesticides are applied with sprayers than with any other type of equipment. There are many types and sizes of sprayers. Sprayers can be as small as an aerosol can or as large as a railway tank car. Application volumes vary from a few litres per acre to several hundred litres per acre.

Since the most common sprayer used in Alberta is the low-pressure, broadcast-boom sprayer the major part of this publication deals with it. This sprayer generally has nozzles tips mounted on a wet-boom at 50 centimetre spacings and applies an even swath of pesticide across the width of the boom. Tapered edge flat fan nozzle tips are used on this sprayer almost exclusively and provide a uniform spray pattern when operated at the optimum pressure and height settings.

Sprayers which are used for row crop application have the nozzles mounted on rubber hoses or drop-pipes which are clamped onto a dry-boom. The nozzles can slide along the boom frame to adjust for various row spacings. Row crop sprayers are generally equipped with even-spray fan nozzles which apply even bands of chemical without overlapping from one nozzle to the next as is the case with

the tapered-edge flat fan nozzle mentioned above. For special applications of insecticides or fungicides cone type nozzles are also used with row-crop sprayers.

Boomless sprayers are generally only used for spraying herbicides in pastures, on roadsides and other areas where rough terrain prevents access to a boom sprayer. However, boomless sprayers are also used to apply insecticides in field perimeters and grasslands. Their use in cropland is not recommended owing to inaccurate spray patterns and the drift potential created by the offset nozzles used on boomless sprayers.

Small sprayers, either hand-operated or vehicle mounted are useful for spot treatment in fields, for spraying lawn areas and for spraying in areas that are inaccessible to larger equipment. These sprayers can be used for applying herbicides, insecticides or fungicides.

Mist blowers are almost exclusively used for applying insecticides and fungicides in orchard and vegetable crops, while foggers of various sizes are used for mosquito and fly control either indoors or outdoors.

The sprayers described above are available in numerous models and types and may be mounted on trailers, tractors, trucks, recreational vehicles or may be self-propelled.

Pump up sprayer

Knapsack sprayer

COMPRESSED AIR SPRAYERS

Since many of the operational procedures suggested for the knapsack sprayer also apply to other types, we will first discuss the various hand-held sprayers, then concentrate on the knapsack models.

Nearly all hand-held sprayers are of the manually operated compression type. There are different sizes, shapes and materials, but the principle is the same. An internal or external compression pump is an integral part of the sprayer. Spray can be discharged onto the target for a short period of time before the pressure drops to where the operator must stop and pump it up again.

Most compression sprayers come equipped with an adjustable nozzle that delivers a cone shaped spray pattern and adjusts from a fine spray to a coarse spray and then to a solid stream that may reach three to five metres.

A typical knapsack sprayer can be described as having a tank capacity of eight to twenty litres which is carried on the operator's back. Continuous hand pumping is required to keep the sprayer operating. Knapsack sprayers are not pre-pressurized as in the pump-up sprayer. The pumping action forces the liquid spray mixture out via a small surge chamber. Some of the pressure is retained in the surge chamber, but spray delivery slows down quickly when pumping stops.

By using a knapsack sprayer an operator can handle larger quantities of spray liquid with greater comfort and freedom of movement than with hand-held compressed air sprayers. Thus knapsack sprayers are adapted for larger jobs.

On some models the pump handle can easily be switched from one side of the sprayer to the other. When large areas are being sprayed this minor difference can be a major advantage.

Stainless steel, galvanized steel and brass have been the predominant materials used for sprayer construction. Plastic units have gained popularity more recently due to their corrosion resistance and light weight. Being able to see the liquid level through the plastic sprayer tank is an additional convenience.

Some pesticides, particularly wettable powders, settle out rapidly when added to water. This can pose a problem with hand operated sprayers with no mechanical or hydraulic agitation system. Therefore hand-held or knapsack sprayers must be shaken periodically during use to prevent the chemical from settling in the tank.

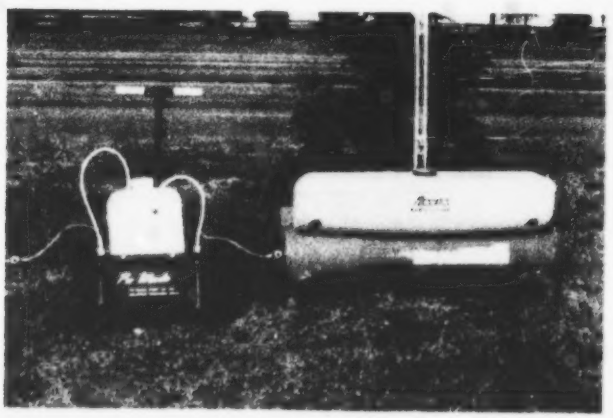
When spraying, the normal pumping and walking action will cause a certain amount of liquid movement in the sprayer. This can be a problem when only a small amount of spray solution is left in the tank. There is still enough liquid to continue spraying but air is introduced into the line. When air is pumped into the line, there is a sputtering of the spray which results in uneven application. This is a signal to refill the sprayer.

A trial with water in the sprayer while spraying a measured area will soon give an indication of how much spray solution is needed to cover a specific area.

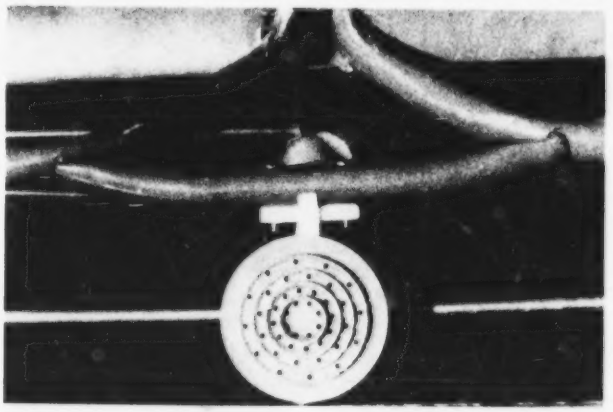
PUSH TYPE SPRAYERS

Push type hand operated sprayers that can be used on large lawn areas are useful for applying herbicides. They usually have a tank capacity of 15 to 25 litres and cover a width of one to two metres.

One type operates on gravity, carrying the spray solution down to a spinning disc. The disc is driven by gears attached to a ground wheel and disperses the spray in a band approximately one metre wide at normal walking speed. The height of the spray disc is not adjustable thereby restricting the use of this sprayer to mowed areas.

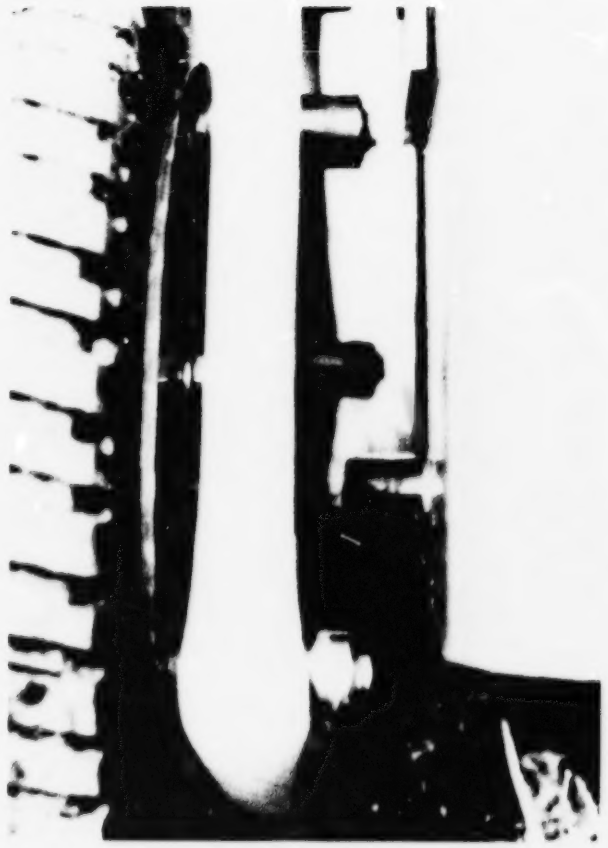


Push type sprayers



Wheel driven disc sprayer

Another model of push type sprayer operates at minimal pressure, which is supplied by a hose pump. The pump is a flexible piece of surgical tubing stretched over a roller reel. The reel is attached to the ground wheel of the sprayer. As each roller revolves it squeezes the tubing creating a vacuum which then fills with the spray solution from the tank. The following roller then squeezes the solution further along the tubing. Adjustment for setting nozzle height is available on this type of sprayer.



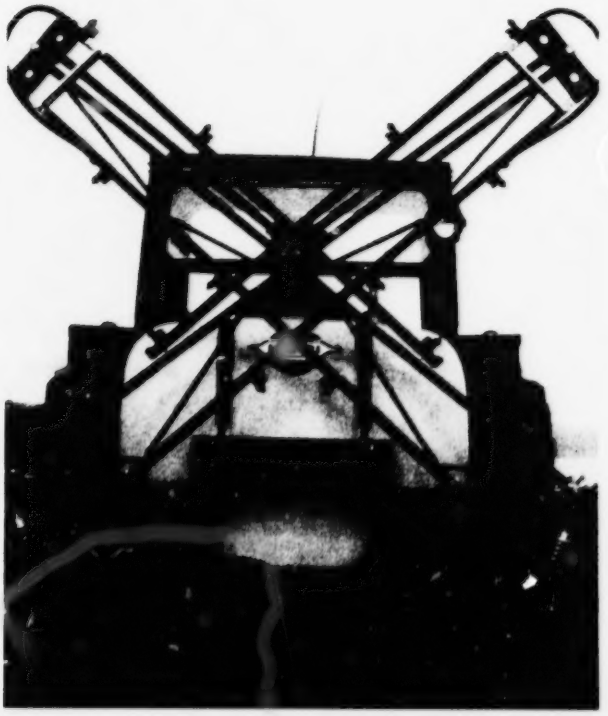
Hose pump sprayer

TRIKE MOUNTED SPRAYERS

These sprayers are equipped with a 12 volt electric pump connected to a tractor battery or the ATV battery. The pump requires only 5 amps to operate and delivers about 4.5 litres per minute at 200 kPa pressure. They can be equipped with a short boom and a handgun for spraying weeds or for spraying trees for insect control.

CAUTION: As there is no agitation system in this type of sprayer, do not use wettable powder formulations of pesticides unless agitation can be provided.

Trike sprayer

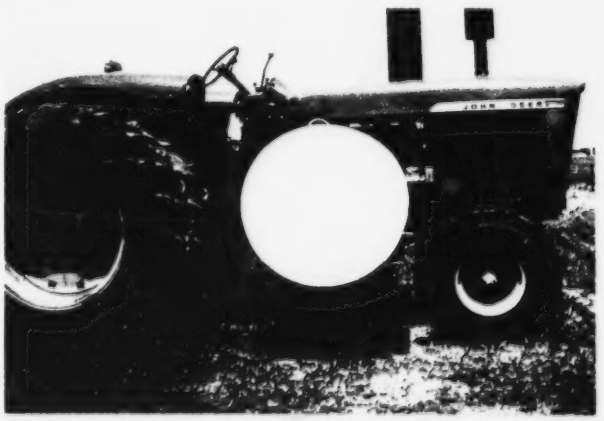


Three point hitch sprayer

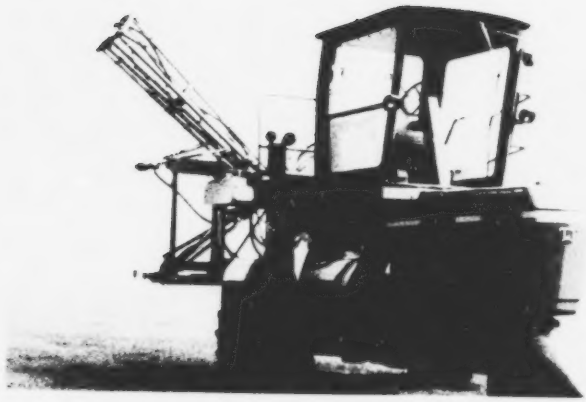
TRACTOR MOUNTED SPRAYERS

Tanks on tractor mounted sprayers usually hold from 500-2000 litres and can be mounted in several positions on the tractor. The pump can be attached directly to the PTO shaft, or may be driven by a hydraulic motor. Booms may be mounted in the front, rear, or belly positions. Broadcast applications may also be made with a nozzle cluster. This boomless type of application may be used in pasture spraying. Tractor mounted units are combined with other equipment such as planters, cultivators or tillage implements.

The tractor-mounted concept is occasionally used for mounting sprayers on swathers, however, large tanks are not used as the frames are unable to support heavy weights.



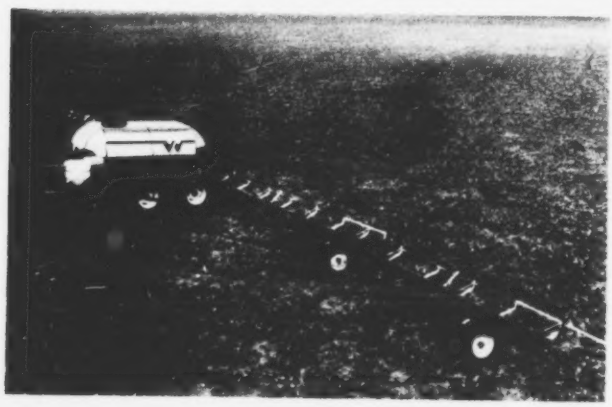
Side mount tank



Row crop sprayer

HIGH CLEARANCE SPRAYERS

High clearance sprayers have evolved from tractor-mounted sprayers and are used for spraying row crops. The tank is underslung and fits between crop rows. The spray boom is raised or lowered depending on crop height and application requirements. An adjustable rear axle allows spraying in a wide variety of row spacings and wheel shields help prevent the wheels from damaging low hanging crops.

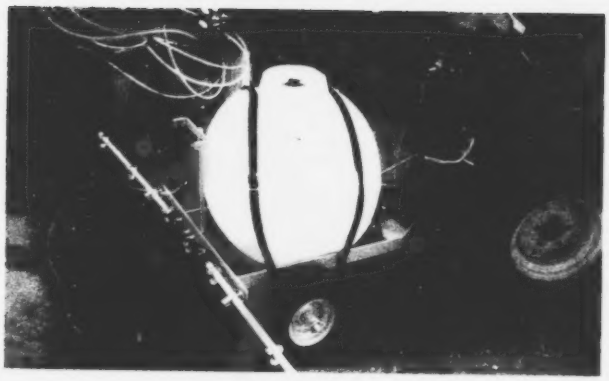


Field sprayer

TRAILER MOUNTED SPRAYERS

The most common type of sprayers used by farmers in Western Canada, trailer-mounted sprayers, are designed to be towed through the field by a tractor. Tank capacity can be as large as 4000 litres with boom lengths up to 24 metres or more. Pumps are mounted on the tractor or sprayer and are driven by the tractor PTO or a hydraulic motor. These sprayers are used to apply most pesticides in cereal and oilseed crops as overall broadcast sprayers. In most cases the nozzles are permanently set at 50 cm spacing in a wet boom.

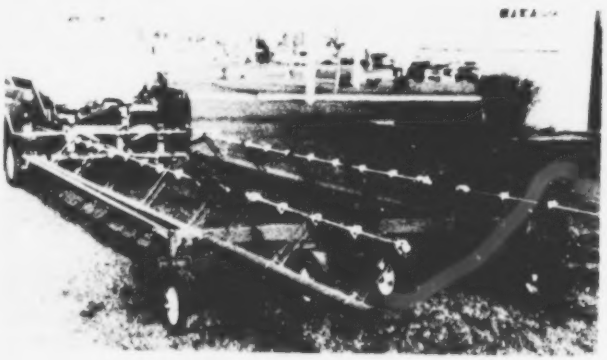
A variety of small trailer-mounted sprayers are commonly used by acreage owners, industrial institutions and by farmers with large lawn areas. These sprayers come equipped with either a 12 volt electric pump or a PTO pump. Handguns can be adapted to allow spraying of trees for insect control.



Estate sprayer

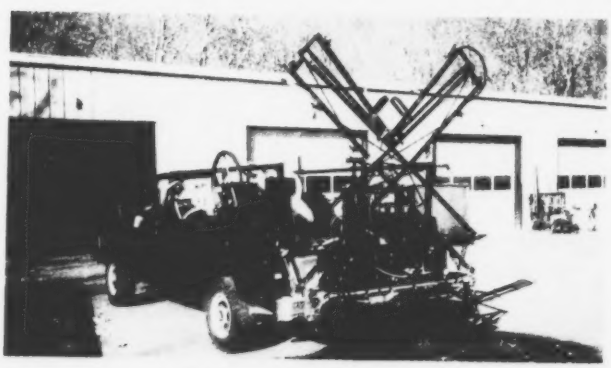
TRUCK MOUNTED SPRAYERS

Sprayers on skids may be mounted in a pick-up or flat-bed truck. Pump power is supplied by an auxiliary engine. Tank size depends on the size of the truck used to carry the sprayer. Attachable booms are available for use in crop spraying. These booms can be detached and the sprayer can be used for pasture spraying, roadside spraying or for any number of industrial situations where it is too rough to use the field size booms.



Removable boom sprayer

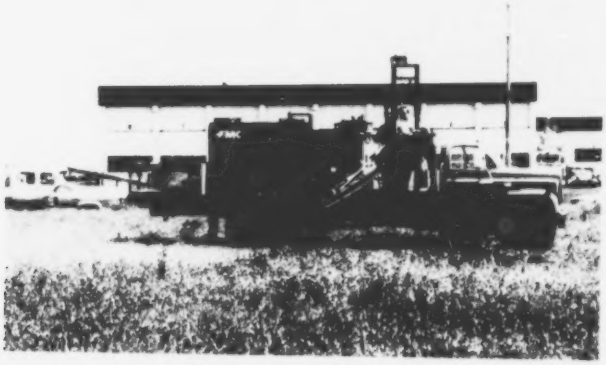
Some models of truck mounted sprayers have a built-in boom that folds up when not in use for crop spraying. Some form of boomless system can be employed when spraying in areas where there are too many obstacles to use booms.



Folding boom sprayer

Larger sized sprayers mounted on large trucks are generally used for roadside spraying for brush and weed control or for spraying other rights of way such as pipelines and power lines. These sprayers are generally equipped with a piston or diaphragm pump which can develop substantially higher pressures for use with a handgun. However, excessive pressure only increases drift potential and is not generally recommended for applying herbicides.

A variety of hydraulic booms are used by municipalities for roadside spraying. Some districts use o.c. nozzles or accutrol nozzles as a boomless type of spraying system. The boomless systems are less costly than hydraulic articulating booms however the spray distribution is not as uniform; the spray swath is limited and boomless systems are more prone to create drift (refer to nozzle section and boom section).

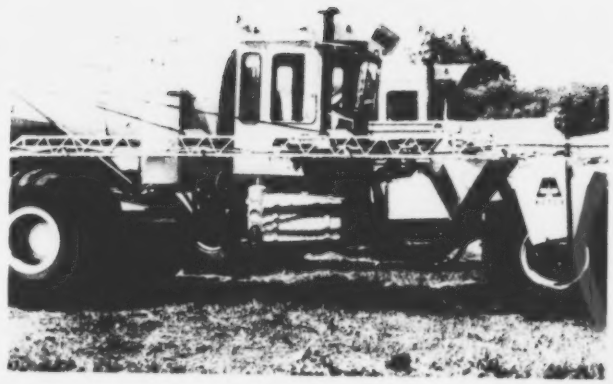


Hydraulic boom

Boomless sprayer

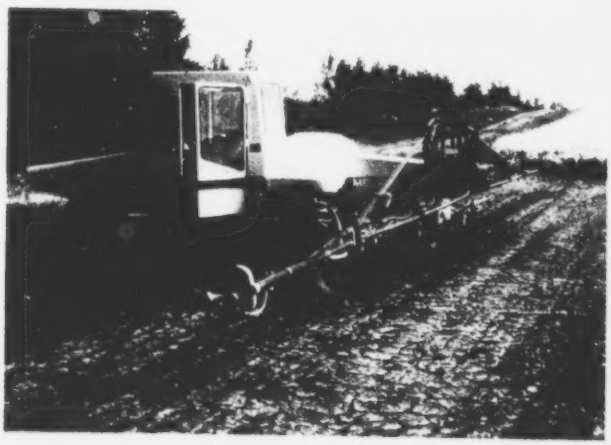
SELF-PROPELLED SPRAYERS

Large self-propelled sprayers have floatation tires. These tires cause less severe crop damage than normal width tires and allow operation under wetter soil conditions. Due to their initial cost "floaters" are best suited for large farmers or custom operations. Some units have a tank capacity up to 10,000 litres. Dust created by the large tires has resulted in poor weed control with some post-emergent herbicides therefore excessive speeds should be avoided for these operations.

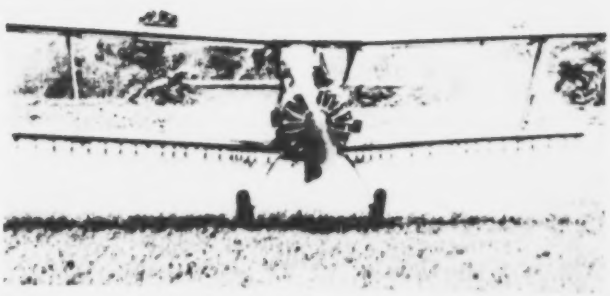


Floater

Smaller self-propelled sprayers, such as the one shown below, have been used for a number of years by Alberta farmers with varying degrees of success. Potential for drift has been lessened by having height adjustment for the boom installed in newer models. These sprayers have high clearance and adjustable wheel width thus allowing for spraying of insecticides and fungicides in later crop stages as well as making them useful for row crop spraying.



Small S.P. sprayer



Aircraft sprayer

AIRCRAFT SPRAYERS

The principal advantages of aircraft sprayers compared to ground equipment are:

- application can be made in places and at times when ground equipment cannot operate
- speed of application will save time
- elimination of soil compaction and crop damage
- no capital investment required by the farmer.

Among the disadvantages to be considered are:

- drift hazard is greater
- not applicable to small fields
- unless properly calibrated and operated, aircraft sprayers are not as thorough in applying herbicides as ground rigs.

Helicopters are more maneuverable than fixed-wing aircraft and are not restricted to operating from a landing strip. However, they are more costly to use than fixed-wing units and have a smaller payload.

Pesticides are applied in either a water or oil carrier, depending upon the chemical make-up of the herbicide.

The label must be consulted for recommendations on rate, addition of an adjuvant, water volume and whether or not the product is registered for aerial application.

Mist blower for tree spraying

MIST BLOWERS

Initially, the most common method of spraying fruit trees was with the use of a high pressure sprayer unit and one or more handguns.

The continual increase in chemical costs along with the market's demand for improved quality of orchard produce created a need for cost effective chemical application. Since that time, the use of a mist blower sprayer has been extended to many other types of crops. Today you find mist blowers in grapes, raspberries, blueberries, hops, date palms, evergreen trees and various types of vegetable farms.

A mist blower can be defined as an air carrier. It uses air as a carrier for the spraying of liquid. Combining air and water as a carrier for the chemicals allows for a higher concentration of spray material which means more acreage will be covered per tank.

Generally, hollow cone nozzles are commonly used on mist blowers. The size of nozzle will provide the correct volume and the type of swirl plate will create the droplet size in conjunction with pressure.

To get 100 per cent coverage, you must replace all the air in the leaf mass with spray loaded air. This same principle applies to the spraying of trees, bushes or vegetables. Another factor to consider is the density of the crop you are spraying. This, together with the weight of the leaves and thickness of the stem, will determine the speed and volume of air necessary for good penetration. This can change between two different varieties of apples, for example, and with their stage of development in the season.

Another fact to consider, especially when it comes to spraying grapes, berry bushes and vegetables, is the bouncing effect the air can have on a very dense leaf mass. Since all crops try to expose the leaf surface to the sun, it can sometimes be hard to get thorough penetration. Some sprayers are equipped with adjustable outlet spouts. Best results have been reached by adjusting these spouts 30° - 45° backwards from the direction of travel. One important factor for good penetration is the forward speed of the equipment. A rule of thumb is never drive faster than 7 km when spraying with a mist blower.

Adjustable spouts

Lightweight portable foggers that can be used indoors or outdoors to dispense chemicals for mosquito and fly control are available in various price ranges. These units are also used for abating noxious odors.

Portable fogger

Motorized knapsack sprayers can be used for liquid spraying and for applying dusts or granules. Some manufacturers offer kits which allow motorized knapsack sprayers to be used for fogging for insect pest control.

Motorized knapsack

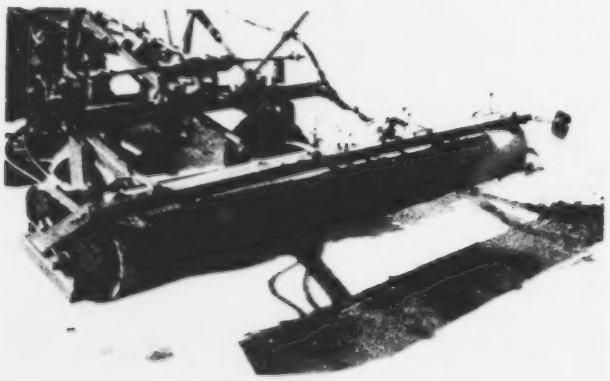
WIPER APPLICATORS

A weed control technique being researched and tried on a limited scale is the use of height-selective applicators. This weed control equipment relies on a height difference between the crop and the weed to achieve selective control. Generally, the weeds must be at least 15 cm above the crop. Several types of applicators are available.

These types of applicators may have a use in row crop situations and other areas where tall growing weeds affect crop production.

Roller Applicator

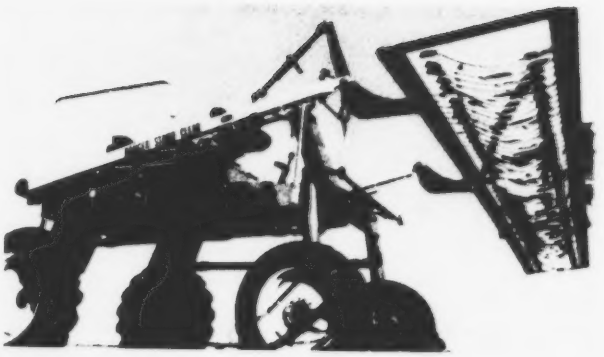
This unit has a rotating roller which is carried above the crop. A herbicide is applied to the roller and is wiped onto the weed growth above the crop.



Roller

Rope-Wick Applicator

This machine operates similarly to a roller applicator. However, the roller is replaced by a pipe which holds the herbicide and is fitted with pieces of rope which are wetted with herbicide through capillary action. The rope wipes the herbicide onto the weeds growing above the crop. Rope-wick applicators can be homemade or purchased commercially.

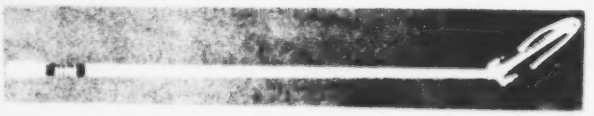


Rope-wick

Hand Held Wipers

Hand held wipers are generally constructed of a plastic pipe shaped like a hockey stick with a rope or ropes mounted on the blade portion. The rope is connected into the pipe to allow chemical solution (in the pipe) to wick through the rope to be wiped onto the vegetation.

This type of weed wiper was designed for the home and garden situation to treat smaller areas and remove unwanted growth near desirable vegetation. The herbicide will control only those emerged plants that are directly contacted by adequate amounts of solution. Repeat treatments will be necessary to control vegetation that was not contacted or did not receive sufficient contact during the initial treatment.



Hand held wiper

All of these systems have advantages and disadvantages.

Advantages:

- Selectivity can be achieved using non-selective control methods such as non-selective herbicides.
- Smaller quantities of herbicides are applied on a per acre basis, reducing chemical use, cost, and soil residues.

Disadvantages:

- The level of control is less than with conventional spraying. Low growing weeds are not controlled.
- Some weeds are not controlled even if adequately contacted.
- Weeds are controlled later in the season, after considerable competition has taken place.
- New equipment is required.
- Travel over advanced crop may cause trampling.

Height-selective applicators will likely develop as a supplement to current weed control methods and will be

used primarily to clean up weeds which have escaped control and to control patch infestations of perennial weeds. Row crops which allow later season traffic without trampling the crop, and control of weeds in forage crops may be other areas where height selective applicators will be useful.

SPRAYER COMPONENTS

Sprayers and other application equipment have three basic functions to perform:

1. Storing chemicals during field application.
2. Metering the quantity of material being applied.
3. Distributing the material accurately in the desired pattern.

To perform these functions sprayers have numerous components which can be arranged in many ways. For a particular situation, the best combination depends on:

— the chemical being applied
— the crop being treated
— the application rate
— the required accuracy.

TANKS

Sprayer tanks are available in a variety of shapes, sizes and materials. Square tanks and tanks with flat bottoms should be avoided as proper agitation and cleaning are difficult. The most popular shapes are the oval tank and the cylindrical tank. They both have good agitation and cleaning characteristics.

Tank sizes should be proportional to sprayer boom width and intended application volumes. Sprayers with a boom 15 metres or wider should have a minimum tank size of 1400 litres. With an application rate of 40 litres per acre travelling at a speed of 8 kilometres per hour and a boom width of 15 metres, a 1400 litre tank would cover 35 acres in just over one hour.

A smaller tank would require more frequent refilling, reducing field efficiency. Larger tanks reduce the number of refilling stops, but require that special attention be paid to the undercarriage to prevent excessive crop damage.

The tank must have a conveniently located, large opening for filling, cleaning and inspecting. An opening of 30-45 centimetres is usually sufficient. The opening should be splash-proof and fitted with a large 80 or 100 mesh screen. The lid should be vented and leak proof. This will help to keep the outside of the tank clean and free from corrosion and pesticide which can contaminate the operator.

The drain hole must be located in the tank bottom to facilitate thorough draining. A liquid level gauge complete with capacity markings is a must.

Tanks are available in galvanized steel, stainless steel, aluminum, fibreglass and polyethylene. Mild steel is not recommended as it corrodes readily, requiring considerable maintenance.

The above mentioned materials are resistant to most chemical corrosion, however, the operator must check the chemical label for instructions and precautions.

Galvanized Steel Tanks

These tanks are inexpensive and are made in a variety of shapes and sizes. They are easily repaired or modified. The biggest drawback is corrosion. Even with protective coatings, chemicals cause rapid rusting. Rust flakes off, plugs nozzles, clogs strainers and damages pumps. Galvanized tanks are suitable for most pesticides but they should not be used with the more corrosive liquid fertilizers.

Stainless Steel Tanks

Stainless steel is the highest quality material for pesticide applicator tanks. It is strong and resistant to corrosion by crop chemicals. Since it is the most expensive material used for sprayer tanks, only equipment with high yearly use is equipped with it.

Aluminum Tanks

Aluminum tanks are medium in cost, resistant to corrosion and are suitable for many chemicals. However, they should not be used for liquid nitrogen solutions. Lab tests have shown that the herbicide TCA has some chemical reaction with aluminum, however, if the tank is cleaned immediately after use no problems should arise.

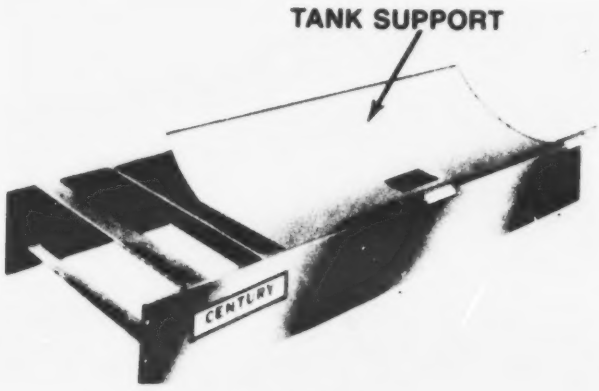
Fibreglass Tanks

Fibreglass tanks are widely used on all types of sprayers and as nurse tanks. Fibreglass is strong and durable, however, it will crack or break under sharp impact. "On farm" repair kits are available for minor problems. The cost of fibreglass is about equal to that of aluminum. Some types of solvents may affect fibreglass tanks.

Polyethylene Tanks

Polyethylene tanks are relatively inexpensive and can be made in many sizes and shapes. They are resistant to corrosion and can be used with all pesticides and with most fertilizers except ammonium phosphate solutions. Polyethylene tanks are tough and durable, however, if one is cracked or broken it must be replaced as there is no effective way to repair it. Since polyethylene breaks down under ultra-violet light tanks should be stored inside when not in use.

Polyethylene and fibreglass tanks must be properly mounted on a "saddle" which supports the tank over a large area. Without it, the weight of the liquid in the tank may damage the tank as the sprayer bounces over rough terrain.



Tank saddle

UNDERCARRIAGE

The undercarriage of a sprayer not only carries the weight of the tank and contents, but also provides the main support for the booms.

Sprayers with large tanks should have enough wheels to provide a level of floatation which will prevent crop damage. The tandem axle or walking beam axle arrangement is preferred. With the wheels following in the same track, compaction and crop damage may be kept to a minimum. The walking beam axle provides a smooth steady support for the booms, maintaining a more even height above the target.

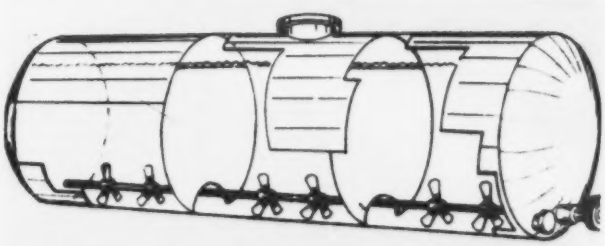
On many of the larger sprayers, both the booms and the trailers are equipped with either floatation tires or tandem wheels. Prairie Agricultural Machinery Institute (PAMI) tests have indicated these are effective in reducing compaction and boom movement, but many farmers are concerned about crop losses from trampling. Trampling from spraying amounts to less than 2 per cent and usually much of the crop recovers. About half of the trampling is caused by the tractor; the only additional loss is from the boom wheels. Thus, sprayers (regardless of design) cause little loss in addition to that caused by the tractor itself.

Walking beam axle

AGITATION SYSTEMS

Intense agitation is required to keep some chemicals in suspension. The return flow from the pressure regulator does not normally provide enough agitation, especially when the pump output drops off. To ensure adequate agitation for all chemicals, a mechanical, or jet agitator should be used in the tank. A jet agitator is probably easier to install in most existing sprayers, although mechanical agitators provide the most positive mixing. Sparge tube agitators may also be used.

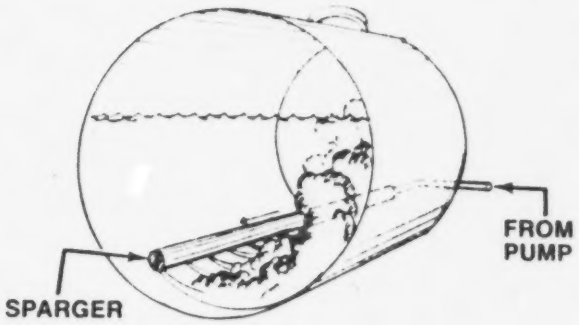
Using only the by-pass return liquid to provide agitation is often inadequate even with full pump output, and as the output decreases the amount of return liquid decreases, thus providing less agitation. No indication of low pump output is given with this system until the return liquid drops to zero.



Mechanical agitator

Mechanical Agitation

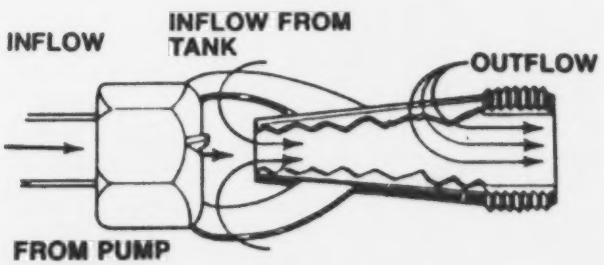
Mechanical agitation can be provided by paddle wheels or propellers driven by electric motors or power shafts from the tractor. Mechanical agitation provides the most positive and thorough mixing possible but the systems are expensive and require a high degree of maintenance. The added expense and complications make them impractical for most farm-type sprayers but they are common on commercial, high pressure, utility sprayers.



Sparge tube

Sparge Tube Agitation

Sparge tubes consist of a perforated pipe or pipes running the length of the tank. The pipe is connected to a pressure line and liquid pumped through it sweeps the bottom of the tank. These devices must not be connected to the bypass since excessive pressure would build up when the booms are turned off. Although sparge tubes do not increase the quantity of liquid in circulation, they do provide uniform agitation throughout the tank.



Jet agitator

Jet Agitation

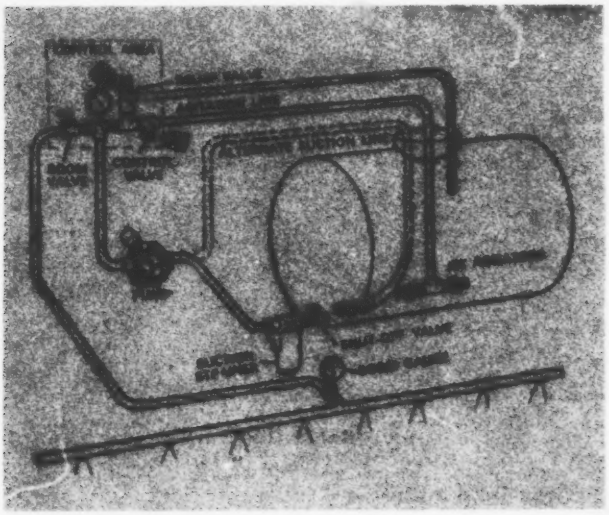
Jet agitators with venturi caps have an output of two or three times their input. Various sizes are available for different sizes and shapes of tanks. A per minute input of about one to two per cent of the tank capacity is recommended.

In order to get adequate mixing of wettable powders, several nozzles are required to get a complete sweep of the

tank bottom. Large flat bottom tanks need more nozzles than do round tanks.

Jet agitators must NEVER be connected to the return line from the pressure regulator as excessive pressure will occur when spray lines are shut off.

Jet agitators must be securely fastened inside the tank to prevent whipping. A throttling valve should be provided in the agitator line to reduce the flow if excess foaming occurs.



Hookup for jet agitator

To adjust for spraying, first close the agitator control valve and open the boom valve. Adjust the relief valve until the pressure gauge reads 75 to 100 kPa above the desired spraying pressure. Slowly open the agitator control valve until spraying pressure is reached. If the pressure won't come down even with the control valve wide open, use a larger orifice in the agitator.

PUMP PERFORMANCE

A variety of pumps can be used on sprayers. Each kind has certain capabilities and limitations that determine when it should be used.

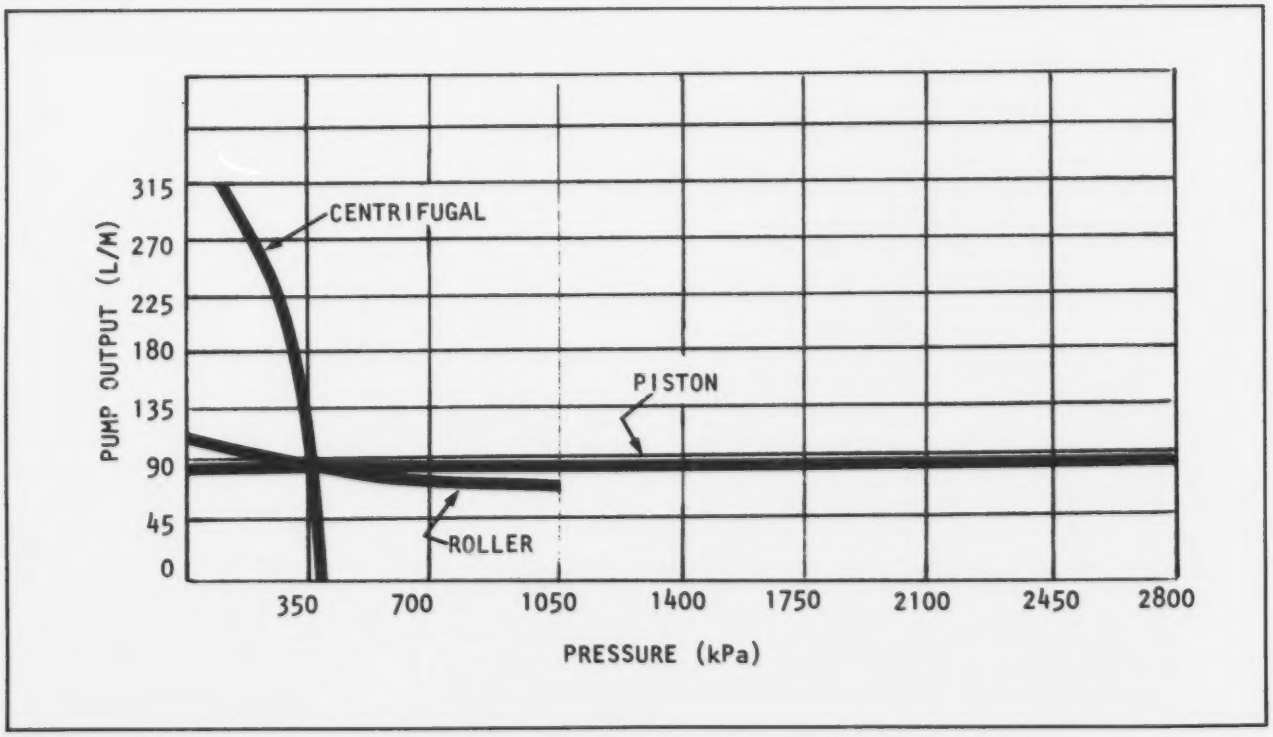
The roller, and centrifugal pumps are the most common types employed on agricultural sprayers.

The roller pump affords relatively low cost, easy upkeep and efficient operation at tractor pto speeds. However, roller pumps tend to wear from continuous use and need replacement. Abrasive material will cause extensive wear in roller pumps. The advantage of centrifugal pumps is that abrasives can be used with them. These pumps can deliver high volume at relatively low pressure in continuous duty operations.

Pump Capacity Check

- Disconnect hose leading from pressure side of pump.
- Attain required rpm.
- Direct pump flow into a container for one minute.
- 'Measure the amount collected and compare with manufacturer's output specifications.

A worn pump is indicated if spraying pressure can not be achieved with boom valves open at the correct rpm.



Pump performance curves

Pump and Plumbing Sizes

Sprayer			Pump Size (L/min)	Plumbing Sizes (I.D. mm)						
Boom Width (m)	Tank (L)	(L/ac)	10 km/h	Pump Ports Inlet	Pump Ports Outlet	Boom Line	Boom Pipe	Bypass Line	Agitator Line	Filter Ports
10	680	40	34	20	20	13	20	13	13	25
	900	40	38	25	20	13	20	13	13	25
12	900	40	42	25	20	20	25	13	13	25
	1130	40	46	25	20	20	25	13	13	25
	1350	40	50	25	20	20	25	13	13	25
15	1130	40	53	25	20	20	25	25	13	25
	1350	40	57	25	25	20	25	20	13	25
	1800	40	65	25	25	20	25	20	20	25
18	1350	40	63	25	25	20	32	20	20	25
	1800	40	72	25	25	20	32	25	20	25
	2270	40	80	25	25	20	32	25	20	25
24	1850	40	85	32	25	20	32	25	20	32
	2270	40	93	32	25	20	32	25	20	32

PUMP AND PLUMBING SIZES

Pumping requirements on a farm sprayer are modest. Pressure is relatively low and volumes required are usually under 100 litres per minute. Nevertheless, adequate pump capacity is a must for proper sprayer functioning. Pump capacity is determined by the following factors:

- rate of application per acre
- width of the sprayer
- speed of travel
- size of tank (agitation requirement).

The table indicates the pumping capacity required for various sprayer sizes. Consideration has been made for agitation requirements and an allowance added for normal wear.

When selecting a pump be sure that its capacity is rated at the pressure you will be operating at. Some manufacturers rate their pumps at zero back pressure and of course this capacity is greater than at 275 kPa.

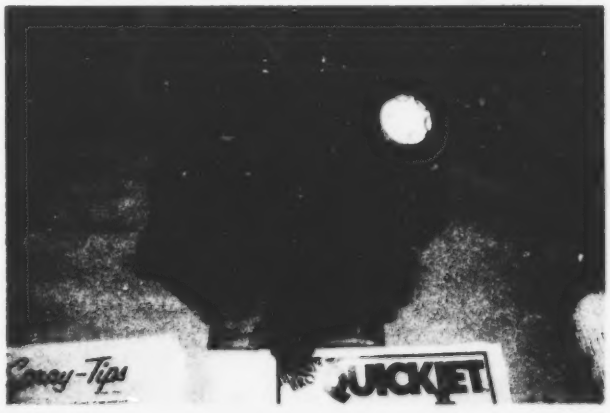
DIAPHRAGM PUMPS

The pumping action in a diaphragm pump is produced by the movement of a flexible diaphragm. Liquid is drawn into one chamber on the downstroke and forced out of another on the upstroke. The diaphragm is resistant to wear by abrasives but may be attacked by certain chemicals.

High volume, high pressure, diaphragm pumps are being used on industrial sprayers with success. Plumbing a diaphragm pump into a sprayer is the same as for a piston pump.

Preparation:

(a) Ensure oil level is at least halfway up oil reservoir. (Hardi Pumps are grease lubricated, so oil is not used.)
(b) Suction lines must be secure and free of air leaks. Sucking air into the system seriously reduces efficiency and can cause chemical to foam.
(c) With at least one boom section open, run the pump for one or two minutes at zero pressure to evacuate all air.
(d) Never exceed recommended rpm.
(e) Ensure plumbing is of adequate size, especially the input side. Also check that there are no restrictions in the line.



Diaphragm pump

Maintenance:

(a) Clean the pump after use by running clean water through for a few minutes. Finish with the suction line out of the water to empty the pump.
(b) Check oil level and if necessary top up with a good 20W/30 oil. If oil changes color, or disappears completely, refer to Problem Solving section.
(c) Change oil every 200 hours, or at the end of the season, whichever is soonest. To drain, remove oil filter plug, normally located at base of the pump body. Rotate the shaft by hand until oil stops flowing. Slowly refill with oil, rotating the shaft by hand at the same time, until the level is halfway up the reservoir.
(d) Replace all diaphragms, valves and 'O' Ring seals at the end of each season.
(e) Completely drain pump for winter storage — especially the manifolds. Protect from frost.

Problems and Causes	Remedy
Pump does not suck. One or more valves damaged or not seating properly.	Check valves and clean valve seats.
Suction filter blocked or restriction on suction side.	Clean filter and check for restrictions in suction line.
Pressure gauge fluctuates badly. Nozzles "spitting". Pump not completely evacuated of air, or is sucking air.	Check suction hose and couplings for air leaks. Rotate pump with outlet taps open, until nozzles stop "spitting".
Pump pulsates and so does pressure gauge needle. Incorrect air pressure in air receiver.	Starting at zero, progressively pressurize air receiver, with pump running until pulsations cease (normally between 25% and 33% of operating pressure).
Water pumped at little or no pressure. Pressure regulator faulty or of insufficient capacity.	Check and repair or replace.
Pump has insufficient capacity for nozzles fitted.	Check flow rates on nozzle chart x number of nozzles. Check chemical recommendations to see if smaller jets may be used. Adjust speed/pressure accordingly.
Output drops and pump becomes noisy. Oil level too low.	Top up with multigrade oil to correct level.
Oil changes color. One or more leaking diaphragms allowing chemical to mix with oil.	Check diaphragms and valves. Drain oil. Refill with oil.
Oil disappears and comes out of discharge pipe. One or more diaphragms split.	Drain pump of oil. Dismantle heads and check diaphragms and valves (remember a broken valve can fall into the cylinder and split the diaphragm). Fit new diaphragms. Refill with oil.
Oil level drops steadily and persistently. Shaft oil seal leaking.	Strip pump and fit new oil seal.

ROLLER PUMPS

Roller pumps are commonly used because of their low cost and compact size. They operate at 540 and 1,000 rpm, they are easily repaired and have adequate capacity for field sprayers. Roller pumps can be used to pump plain water and other pesticide solutions including wettable powders. The roller material should be compatible with the solution being pumped. Always check manufacturer's information on pump use.

The rollers of a roller pump fit into slots of a rotating hub. The slots allow the rollers to follow the eccentric shape of the housing. As the rollers pass the inlet port, the space between rollers and the housing becomes larger and draws fluid into the pump. The fluid remains between two rollers as it moves to the outlet port. As the rollers near the outlet port, the spaces become smaller and the fluid is expelled from the pump.

Roller pump

The output from a roller pump decreases substantially as the operating pressure increases because the rollers tend to let more fluid leak back between rollers.

Preparation:

- Rotate shaft by hand to ensure pump has not seized.
- Ensure pump is securely coupled.
- Suction lines must be secure and free of air leaks. Sucking air into the system seriously reduces efficiency and can cause chemical to foam.
- With at least one boom section open, run the pump for one or two minutes at zero pressure to evacuate all air.
- Never exceed recommended rpm.
- Ensure plumbing is of adequate bore size - especially on the inlet side. Also check that there are no restrictions in the line.

Maintenance:

- Always flush pump thoroughly with lubricating oil after use.
- Test the pump at the end of each season by running it at 275 kPa pressure and checking that the flow is sufficient for maximum sprayer application required.
- Examine condition of rollers. If reduced in size, or worn to a 'conical' configuration, pump should be reconditioned or replaced.
- To recondition the pump, replace all rollers and seals. Take great care in correctly locating seals on reassembly. If shaft is badly worn, it should be replaced. This can be difficult, and purchase of a new pump should be considered. If the inside of the pump body is worn or corroded, a new pump should be purchased.

It is normally not possible to satisfactorily recondition a roller pump more than once.

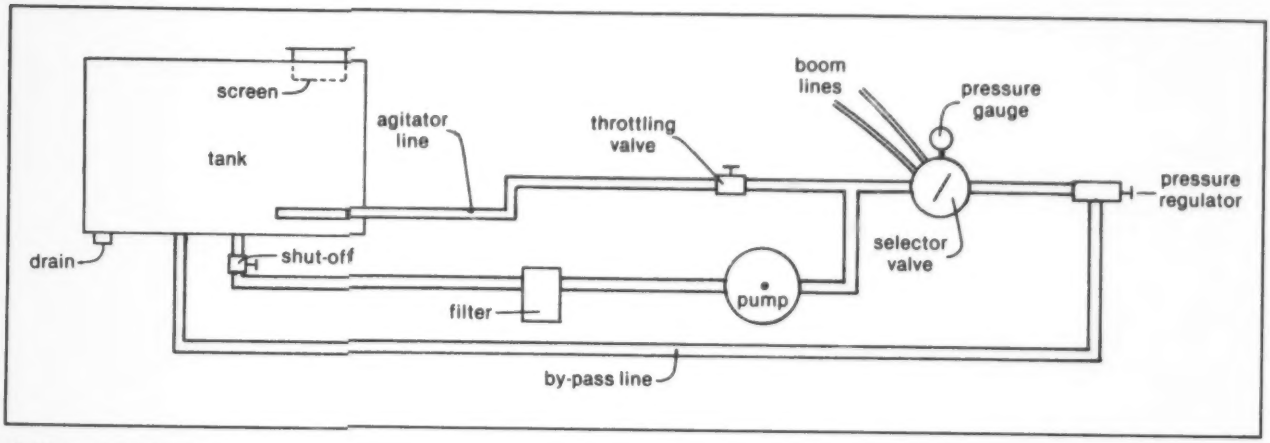
Capacities Of Common Roller Pumps

Pump	Max. rpm	Output (volume)
Hypro 7560	1000	42 L/min @ 540 rpm & 345 kPa
Hypro 7700	900	47 L/min @ 540 rpm & 345 kPa
Hypro 1700	600	77 L/min @ 540 rpm & 345 kPa
Hypro 1500	800	114 L/min @ 540 rpm & 345 kPa
Hypro 6300	1200	57 L/min @ 1000 rpm & 345 kPa
Hypro 7560	1000	82 L/min @ 1000 rpm & 345 kPa
Hypro 1700	1000	164 L/min @ 1000 rpm & 345 kPa
Delavan 66-3000	850	32 L/min @ 550 rpm & 345 kPa
Delavan 6-0000	1000	35 L/min @ 550 rpm & 345 kPa
Delavan 77-3000	850	45 L/min @ 550 rpm & 345 kPa
Delavan 7-0000	850	50 L/min @ 550 rpm & 345 kPa
Delavan 7-3110HS	1000	58 L/min @ 1000 rpm & 345 kPa
Delavan 7-4110HS	1000	58 L/min @ 1000 rpm & 345 kPa

Roller Pump Hookup

A general hookup of a roller pump for spraying appears on the next page. Agitation is accomplished by a hydraulic or jet agitator, using part of the output from the pump to create an increased liquid flow to keep the material from settling out. The relief valve protects the system and is used in setting spraying pressure.

Problems and Causes	Remedy
Pump does not suck. Rollers worn out.	Replace rollers and seals or replace pump.
Air entering inlet side of pump.	Check inlet coupling and plumbing for leaks. Rotate pump with outlet taps open.
Suction filter blocked.	Clean suction filter.
Pump becomes noisy. Pump starved.	Check inlet plumbing for restrictions.
Rollers worn out.	Replace rollers and seals, or replace pump.
Inside of pump body badly worn or corroded.	Replace pump.
Running too fast creating cavitation.	Slow down PTO speed.
Pressure and output drop. Rollers worn out and/or inside of pump body worn or corroded.	As for above.
Restriction in line.	Check inlet and outlet and rectify.
Nozzles spitting. Air leaks on inlet side.	Check inlet/suction hose and couplings for air leaks. Ensure all washers and seals correctly positioned.



Roller pump hookup

PISTON PUMPS

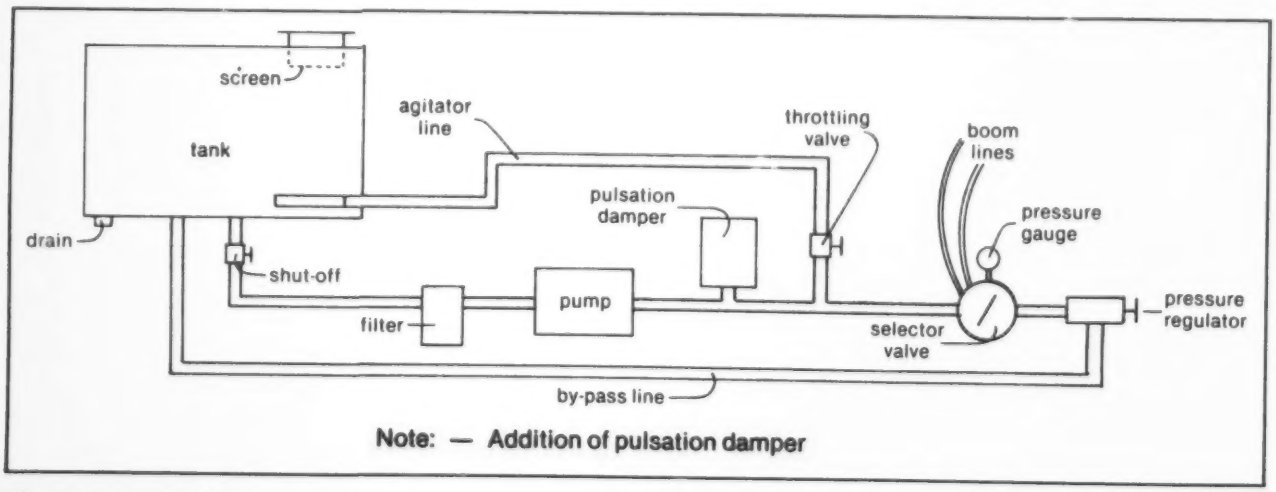
These pumps are primarily designed for high-pressure spraying applications. Piston pumps are positive displacement pumps, which means that output is proportional to speed and virtually independent of pressure. They are a good pump for wettable powder suspensions and other abrasive liquids. These pumps are suitable for use on field sprayers but are not commonly used owing to their high purchase price. However they are one of the best types of pumps for custom operators or on any utility sprayers.

Piston Pump Hookup

The connection for a piston pump is similar to that for a roller pump except that a surge tank has been introduced at the pump outlet. This accessory reduces the line pulsation that is characteristic of piston pumps.

In spraying applications where pressures well below 1400 kPa are usually adequate, the system may be connected with a standard relief valve in place of the unloader valve as in the diagram for roller pumps. When pressures over 1400 kPa are used, the relief valve should be replaced by an unloader valve. This decreases the pressure on the pump and the load on the engine or motor when the spray gun or boom valve is closed.

Piston Pump

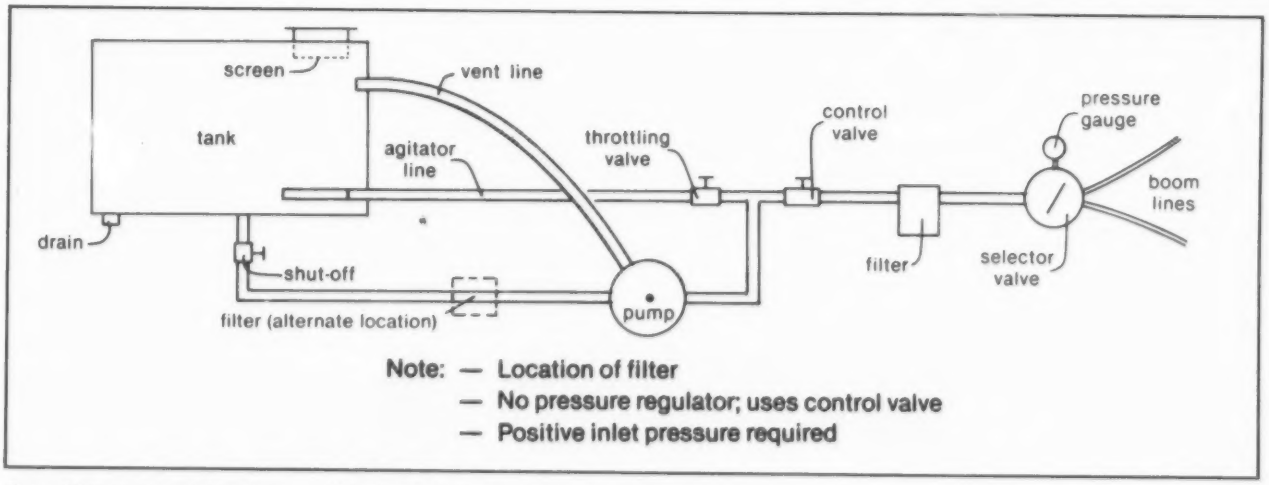


Piston pump hookup

CENTRIFUGAL PUMPS

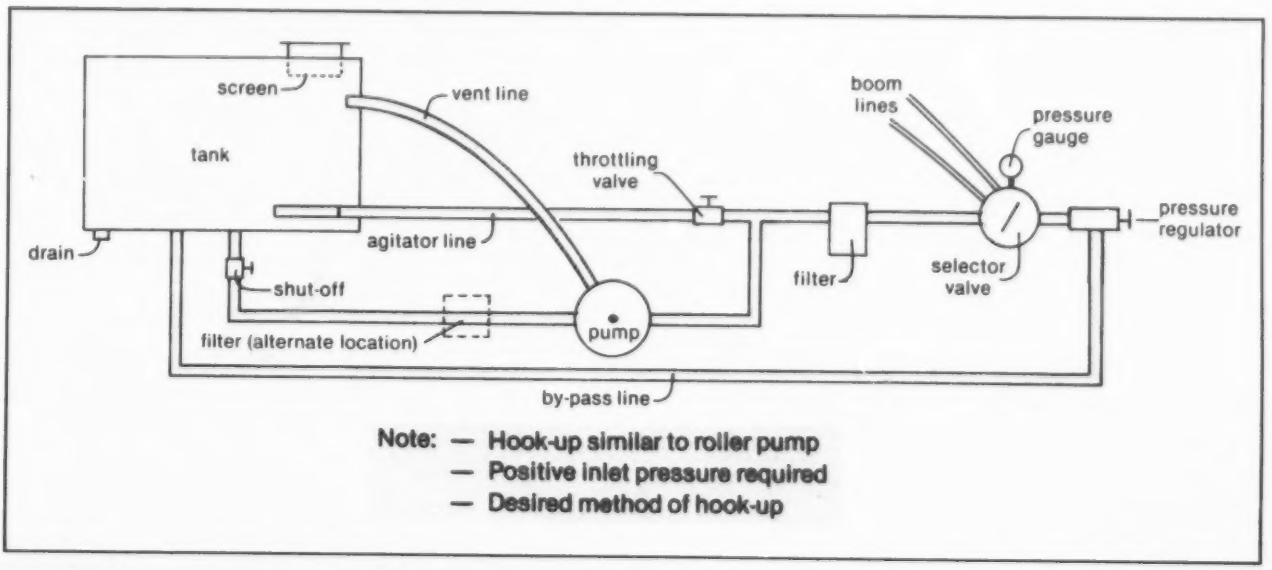
Centrifugal pumps have become increasingly popular as they handle abrasive materials well, and have a high capacity to provide adequate hydraulic agitation. Centrifugal pumps must be driven at high speed to develop pressure by belt, gear, or hydraulic drives. Pump output falls off rapidly after 300 kPa pressure. The centrifugal pump's main disadvantage is that pump output decreases rapidly with small reductions in pump speed. Turbine pumps have similar characteristics to the centrifugal pumps but run at a lower rpm.

Centrifugal pump



Note: — Location of filter
— No pressure regulator; uses control valve
— Positive inlet pressure required

Centrifugal pump hookup — No P.R. Valve (see page 19)



Note: — Hook-up similar to roller pump
— Positive inlet pressure required
— Desired method of hook-up

Centrifugal pump hookup — c/w P.R. Valve (see page 19)

Troubleshooting Hydraulic Driven Centrifugal Pumps

Problem	Causes and Remedies
1. Pump doesn't deliver flow	a. Suction strainer clogged: clean strainer. b. Loss of prime: install sump or anti-vortex fitting in tank. — make sure discharge end of bypass or agitation line positioned below liquid level in tank — run a vent line from top most vent plug in pump volute to spray tank to bleed off air — check suction plumbing for leaks. c. Collapsed suction hose: replace with wire-reinforced hose and increase hose size if undersized. d. Impeller stuck or clogged: remove volute and check for foreign object and rotate impeller. e. Too much suction lift: reduce amount of suction lift.
2. Liquid leaking at juncture of centrifugal pump and hydraulic motor	a. Pump seal leaking: follow pump disassembly instruction and replace face seal. b. Motor seal leaking: follow pump and hydraulic motor disassembly instructions and replace seal.
3. Lack of pressure developed by centrifugal pump	a. Insufficient motor speed on "open-centre" hydraulic systems: adjust motor speed (On Deere "closed-centre" systems inadequate motor speed should not be a problem when using orifice.) b. Excessive restriction on discharge side: increase discharge hose and fittings up to recommended size, check for clogged line strainer or pump capacity may be exceeded.
4. Inability to reduce pressure to desired spraying range	a. Excessive motor speed on "open-centre" hydraulic systems: adjust motor speed (On Deere "closed-centre" systems excessive speed should not be a problem when using metering orifice.) b. Bypass or agitator plumbing too restrictive: Increase size of hose and place pressure gauge as near to spray nozzles as practical.
5. Hydraulic fluid becomes too hot	a. Clogged oil filters or dirty oil: replace hydraulic oil and filters at recommended intervals. b. Improper system maintenance: keep hydraulic oil at proper level, clean dirt from system, keep relief valves adjusted properly and check for dented or kinked lines. c. Incorrect application of hydraulic motor: check tractor specifications.
6. Hydraulic motor operates in an erratic manner	a. System trouble: check system for air or fluid leaks. Check fluid for proper quantity and viscosity. b. Motor wear: inspect motor for excessive wear caused by impurities in system. Replace if necessary. c. Hydraulic hose quick-couplers not transferring oil from tractor hydraulic system: be sure coupler ends are clean and locked together in the operating position.

Centrifugal Pump Hookup

- A small plastic vent tube leads from the top drain opening in the pump housing back to the tank. This positive vent line allows the pump to prime itself by bleeding off trapped air when the pump is not operating. The small stream of liquid that flows back to the tank when the pump is operating is negligible.
- No relief valve is used.
- Inasmuch as the primary purpose of the line strainer is to prevent clogging of the spray nozzles, it is shown in the line to the boom or spray gun. A small strainer is adequate in this position as much of the pump output is recirculated. Alternate locations are in the suction line, if its capacity is adequate for the pump, or at the pump outlet, if it is also sturdy enough to withstand full pump pressure. In either of these locations it will help to clean the tank by straining out sediment as the solution circulates.
- Two flow control valves are used — one in the agitation line and one in the line leading to the boom — with shut-off valve — or spray gun. This permits control of agitation flow independently of nozzle flow.

Maintenance Instructions:

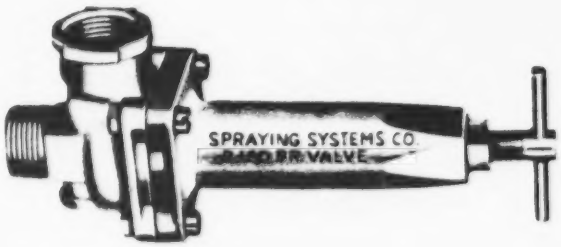
When the unit is not to be used for an extended period of time, follow these instructions:

- Plug the hydraulic motor ports to retain some hydraulic oil in the motor and prevent internal rusting.
- Remove the bottom vent plug in the pump and drain the fluid. Flush some light oil in the pump to cover internal parts and prevent rusting.
- Always rotate impeller by hand to be sure the unit is free before reusing.

Ground drive pump

GROUND DRIVEN METERING PUMPS

Metering pumps are driven by a ground wheel. When speed changes, the rate of pumping increases or decreases proportionately. Thus, the application rate is held constant. Variable-stroke piston pumps are designed to change the length of the piston stroke to adjust the application rate. Increasing the piston stroke increases flow; reducing the stroke cuts the flow. Some pumps have a dial setting to indicate the output required. Other models require changing the sprocket size according to the desired volume. These types of pumps are mainly used in liquid fertilizer applicators, however, some manufacturers of herbicide sprayers offer these pumping systems.



Pressure relief valve

PRESSURE REGULATORS

Relief Valve

A relief valve is a safety device that releases liquid when the pressure exceeds a safe level. Relief valves can be used to regulate sprayer pressure by adjusting them to open at the desired setting. When used this way, the valve is always partly open while the sprayer is operating. The excess flow is bypassed back to the tank.

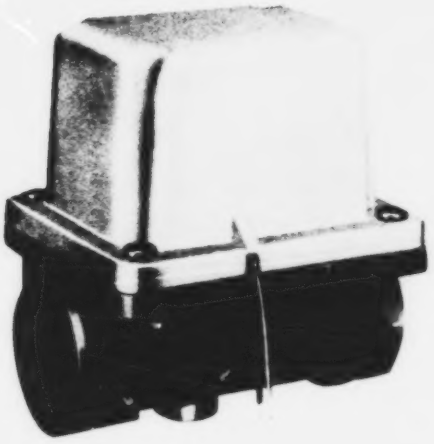
Unloader valve

Unloader Valve

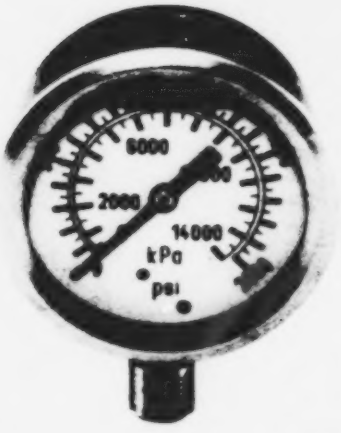
Spraying systems operated at pressures over 1400 kPa should use an unloader valve in place of a relief valve to unload the pump when the distribution system is turned off. An unloader valve opens and enables the pump output to flow back to the tank at low pressure. This reduces pump wear as well as relieving the pressure on the entire system.

Electric Pressure Regulators

This type of regulator provides remote pressure control in agricultural spraying applications. Wetted metal parts are made of stainless steel with nylon body and polypropylene cover for the gear motor. The valve operates on a 12 volt system at pressures up to 700 kPa.



Electric pressure regulator

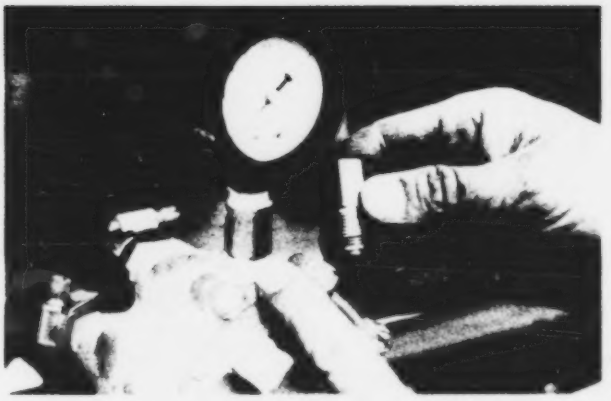


Pressure gauge

PRESSURE GAUGES

The importance of this item is often overlooked. Its reading is an indication of the rate of application being applied. A spare, accurate gauge should be kept on hand in case of failure and for checking boom pressure.

Pressure gauges should have a total range of twice the maximum reading expected. Gauges reading 0-450 kPa or 0-700 kPa are satisfactory. Gauges should be checked yearly for accuracy. If in doubt, replace the gauge as it is not an expensive item. The gauge should also be equipped with a pulsation damper to prevent damage and to keep the needle from fluctuating. Several manufacturers have glycerin or oil-filled gauges available. The liquid filled gauges dampen any pump pulsations which can damage the gauge and make reading it difficult.



Gauge dampener

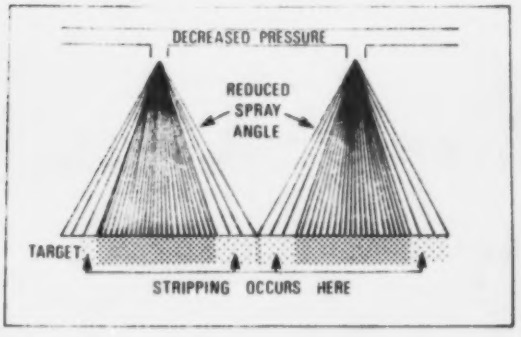
Ideally, sprayer pressure should be taken at the boom near the nozzle; however, most sprayers have the gauge located on the selector valve. To check gauge reading accuracy, a second gauge may be temporarily attached to the boom and readings compared to the one mounted on the selector valve — (THESE READINGS SHOULD BE IDENTICAL). Several sprayer manufacturers have the gauge connected so that it reads actual boom pressure. This is accomplished by running a small flexible line from a boom mid-point to the control location.

PRESSURE LOSS

In any system where flow of liquid is involved there are pressure drops between the pump outlet and the discharge point. The amount of pressure loss depends upon:

- size of hose
- length of hose
- flow rate and
- other fittings in the lines (restrictions).

In field sprayers, the pressure gauge is usually located close to the pump outlet and there can be significant pressure loss by the time the liquid reaches the nozzle. With adequate lines and fittings and proper design, this loss can be kept at a minimum. Many older sprayers (particularly those which were originally designed to apply 20 litres of spray per acre) show severe pressure losses when operated with larger nozzles. Losses as high as 150 kPa can occur and cause severe distortion of the spray pattern, as well as a significant reduction in the application rate.



Results of decreased pressure

PIPE AND HOSE FRICTION TABLES

FLOW	PRESSURE DROP IN kPa FOR PIPE SIZES 3m LENGTH				
IN L/min	½"	¾"	1"	1¼"	1½"
10	2	1			
15	5	1			
20	9	2			
25	13	3	1		
30	19	4	1		
40	32	8	2		
50		12	3	1	
60		17	5	1	
70		22	7	2	
80			9	2	
90			11	3	1
100			13	3	1

NOTE: The above figures are for standard pipe of either seamless or welded construction, in good clean condition. Recommended maximum capacity to keep velocity at approximately 1.5 m per second is shown above heavy lines.

FLOW	PRESSURE DROP IN kPa FOR VARIOUS HOSE SIZES				
IN L/min	½" I.D.	⅝" I.D.	¾" I.D.	1" I.D.	1¼" I.D.
10	17	5			
15	40	12			
20	67	20	8		
30		45	17	4	
40		72	29	7	
50			44	11	
60			61	15	5
70			83	20	7
80				26	9
90				32	12
100				38	14

NOTE: The above figures are for standard hose in good, smooth condition (7.6 m length with no couplings).

Pressure drop can also occur on the inlet or suction side of the pump. The allowable restriction at this point is critical, since the pump output and life can be affected. A total pressure drop of less than 30 kPa is desirable. This includes the total drop through fittings, filter and inlet hose. Since most filters, when clean, cause a pressure drop of 15 to 25 kPa (depending on the flow rate), it is necessary that the remainder of the suction line not cause a pressure drop of more than 15 kPa at maximum flow. Hose and fitting sizes must be correctly chosen. A large pressure drop will shorten the pump life and drastically reduce output.

Pressure drops can be reduced by selecting the correct line sizes, minimizing the number of fittings, elbows or sharp bends and reducing the length of hoses as much as possible.

Every attempt should be made to use the largest fittings that are available for the hose size. To illustrate how serious these restrictions can be, a 30 cm length of 6 mm pipe inserted in a 12 mm line carrying 16 L/min would cause a pressure drop of nearly 55 kPa, or over twice the pressure drop in a 4.5 m length of 12 mm diameter hose.

Because of the relationship between spray nozzle, pressure, and height of spray boom, it is important that the desired pressure be maintained at the nozzles. Usually the pressure at the nozzles can only be determined by placing a pressure gauge in the boom itself.

Note: Use of ball check strainers at the nozzles requires a 35 kPa increase in pressure to maintain correct nozzle output.

FILTERS AND STRAINERS

Precautions:

a) Loss of flow and/or pressure is often the result of blocked filters. Clean regularly, and carefully observe safety precautions for handling contaminants.
b) Excessively fine filtration can cause a proportion of certain wettable powders to be 'screened off', and the chemical manufacturer's recommendations should always be checked.
c) Mesh size refers to the number of holes per 25 millimetres.

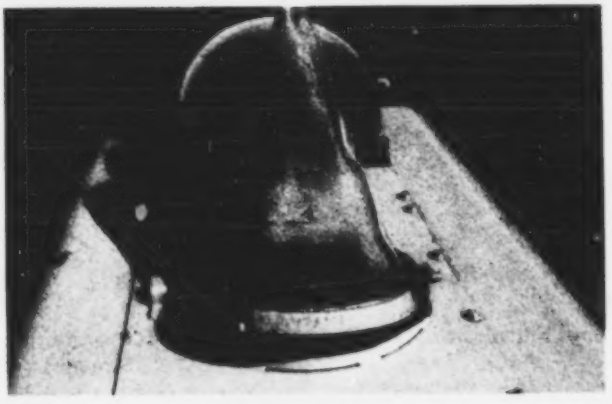
NB: The filters should be located where risk of damage is minimized, but where access for cleaning is not inhibited.

General Principles:

Filtration should be operated in stages, starting with a coarse mesh and progressing to finer screens at strategic points along the direction of flow. The mesh sizes selected will depend upon the rate of flow of the liquid, and the nature of the chemicals in it.

The stages of filtration in a sprayer are generally as follows:

a) **Filtration into the tank via the foot strainer and the basket strainer.** An 80 or 100 mesh screen should be used in the tank filler opening. This will effectively prescreen the material before it enters the tank.



Basket strainer

Foot valve

b) **Filtration between the tank outlet and the pump, via the suction strainer.** This provides protection for the pump, and preliminary screening of the liquid prior to the pressure filters. This filter is located between the tank and the pump when using roller, piston and turbine pumps and located between the pump and booms when using a centrifugal pump. The reason for this is that the centrifugal pump can handle foreign material without damage. By having the filter between the pump and booms, a much smaller volume of tank solution is filtered. A 50 or 60 mesh filter is satisfactory for most solutions. Wettable powders require a 50 mesh filter. In order to maintain efficient filtration, without restricting liquid flow, the screen area should be as large as possible, with adequate clearance around the element in the filter housing.

Felt filters have been replaced by metal screen filters as they provide more filter area, are easier to clean and handle wettable powders.

Suction or pressure line strainer

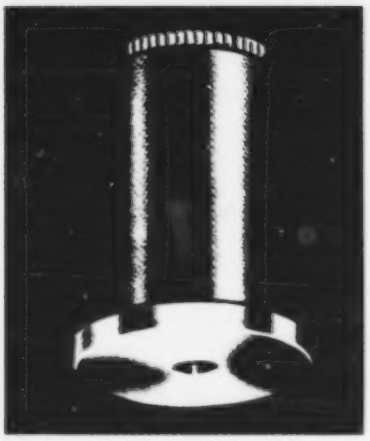
c) **Filtration between the pump and the nozzle tips.** Pressure line strainers are the most efficient pressure filters. These are fitted either:
- — Between the pump and the pressure regulator, requiring one large pressure line strainer.
- — In each hose, feeding the individual spray boom sections.

Nozzle Strainers

In order to help prevent nozzle tip plugging, nozzle tip strainers are recommended. The strainers stop dirt and other particles before they can plug the orifice.

The size of strainer depends on the tip size and the type of solution. A 50 mesh screen or equivalent slotted strainer is normally sufficient for larger tips (02 and up) and for wettable powders. An 80 or 100 mesh screen is normally used with smaller tips.

Always check whether the chemical manufacturer has made filtration recommendations on the label.

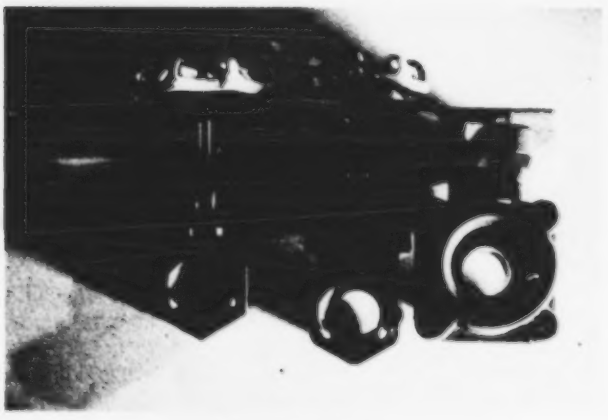


Nozzle strainer

VALVES

Valves are required at several points throughout the plumbing system of the sprayer. Depending on the application, gate valves or ¼-turn ball valves are recommended. Valves are required to control the agitation system and the hand gun. A ball valve is normally installed on the suction line upstream from the main filter. This enables cleaning of the filter while there is liquid in the tank. A valve on the tank drain is very handy and can be installed to replace the drain plug. This makes cleaning the tank much more convenient and reduces the chances of the operator coming in contact with the chemical mixture while draining the tank.

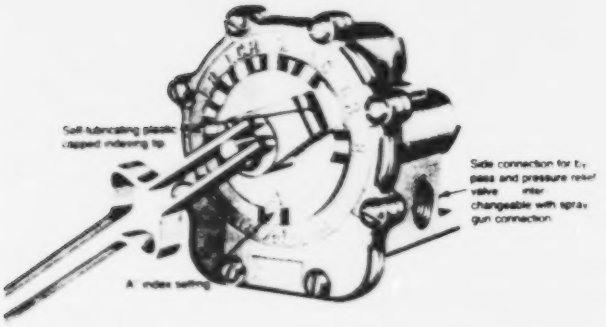
Gate valves (centre) or ball valves (right) are preferred to globe valves, (left). Owing to the design of a globe valve, liquid passing through it must make two 90° turns thus restricting low. Globe valves may be used in lines which require throttling such as the agitation line.



Control valves

Boom Controls — Control valves used to regulate the flow of liquid are those valves other than the pressure regulator. One of the most common is the 3-section-boom control. This type of control valve permits up to 8 different spraying patterns.

The type of control valves used on a particular sprayer will depend on operating requirements and personal preferences.

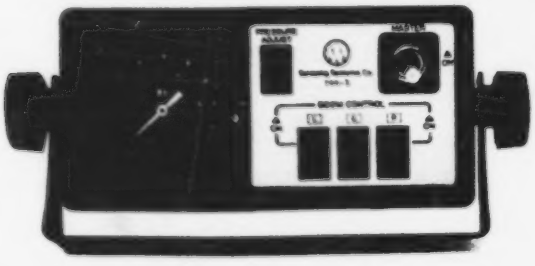


Three-section-boom control

Electric solenoid valves are available in materials resistant to all common herbicides. These valves may be mounted on the sprayer and controlled remotely from the driver's seat. Advantages include easier, faster control, a shorter and less complex plumbing system, and increased operator safety as there are no hoses with chemical near the operator. Pressure drop from the inlet to the spray line outlet is about 35 kPa with most electric solenoid valves.

Electric solenoid valve

A sprayer control system provides on/off control of sprayer booms, plus control of sprayer pressure from the seat of the tractor or truck cab.



Remote boom & pressure control

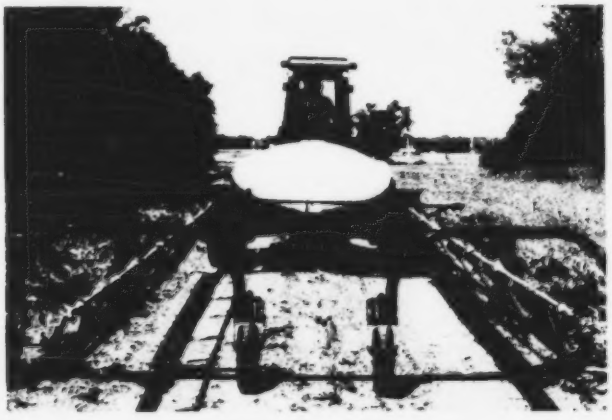
HOSES

Hoses convey the liquid through the sprayer. Liquid pressure varies at different points on the sprayer. Hoses and pipes must be strong enough to prevent bursting. The rated working pressure of a hose decreases as the diameter increases. Be sure hoses are rated for higher capacity than the expected operating pressure to provide a margin of safety and avoid bursting from pressure surges.

Suction hoses are not pressurized and will not burst, but they can collapse if the inlet becomes plugged. Suction-hose diameter should be at least as large as the pump inlet port. The hose must be chosen carefully and should be of the noncollapsing, wire-reinforced type. A collapsed suction hose can restrict flow of liquid and "starve" a pump, causing decreased outflow and greatly accelerated wear.

The inner and outer layers of all hoses should be resistant to the chemicals to be used. Check with both the chemical supplier and the hose supplier if there is any doubt. A hose weakened by chemical attack can leak or burst unexpectedly.

Hose size is important because pressure losses affect flow rates. Pressure loss depends on hose diameter, length and flow rate. Although pressure losses may not seem significant in hoses shorter than 2 metres it's wise to always use hose of the recommended size to minimize pressure and power losses.



Broadcast boom

BOOM SYSTEMS

The boom is usually made of aluminum because of its light weight; however, galvanized steel pipe is also used because of its higher strength. The pipe size depends on sprayer width and application rates. A 25 mm diameter pipe is normally satisfactory for larger sprayers while a 20 mm tube is sufficient for smaller ones.

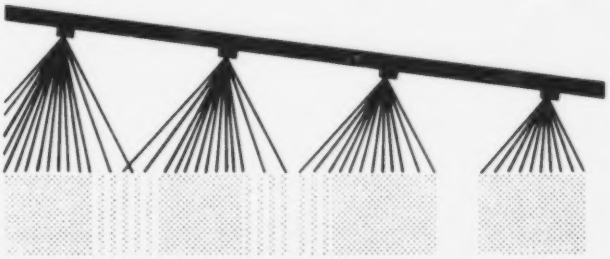
The boom of a sprayer is normally mounted on a support to provide stability and to maintain correct boom height. Whipping, either horizontal or vertical, can result in changes in application rate of 25 to 30 per cent at the boom end when the wheel goes over a 5 cm bump. Castering boom support wheels should be locked into position to provide more directional stability. Locking in transport is also necessary to avoid wheel whip experienced with the non-rigid support of caster wheels. The maximum width of sprayer booms which will give good coverage will depend on the levelness of the fields. In areas with rolling land,

ravines and short steep slopes, the use of very wide sprayers should be avoided. In these situations, it is impossible to maintain correct boom height with a very wide boom. The height of the boom should be easily adjustable between 25 and 100 cm or higher. A convenient adjustment is necessary to allow spraying at a forward angle of 45° without the spray hitting the boom wheels or frame. Booms should fold easily for transportation.

Booms must be stable. Unstable booms produce an erratic spray pattern which results in uneven weed kill and/or crop damage. Poorly supported booms, and booms that are too long, will "whip" in the field. Two types of boom whip encountered are vertical and horizontal.

Vertical Boom Whip

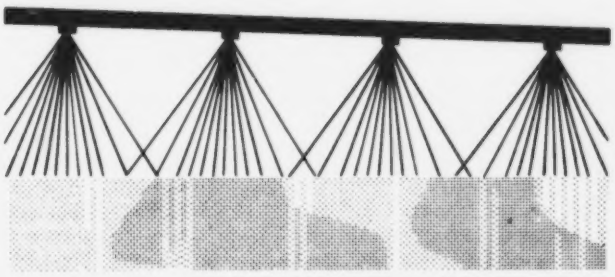
On uneven ground, the ends of long, unsupported booms whip up and down. This produces uneven application. Outrigger wheels will reduce vertical whip to a minimum.



Vertical whip

Horizontal Boom Whip

Rough ground, poorly braced booms, and a loose hitch between the sprayer and tractor can combine to give horizontal boom whip. This will produce a patchy spray pattern. Stabilizer bars, securely pinned drawbar, and a ball and socket hitch will help to eliminate horizontal whip.



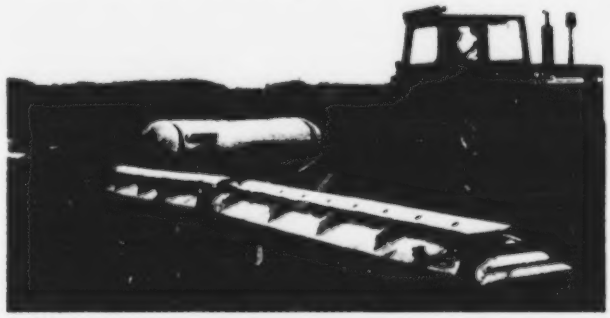
Horizontal whip

Self-Stabilizing Booms

Many tractor mounted and truck mounted sprayers come equipped with booms without outrigger wheels. Booms without wheels, supported by chains or cables, have a tendency to bounce and dig into the ground while turning in the field. The newer types of booms are trapeze mounted (either single or double) and tend to be more stable than chain supported booms especially in rough fields. A skid is mounted on the outer ends of these booms to prevent the nozzles from contacting the soil surface.

Shrouded Booms

Sprayers with booms covered by various sorts of wind-protecting shields have appeared on the prairie market. The obvious advantage is that they allow spraying to continue in windy conditions.

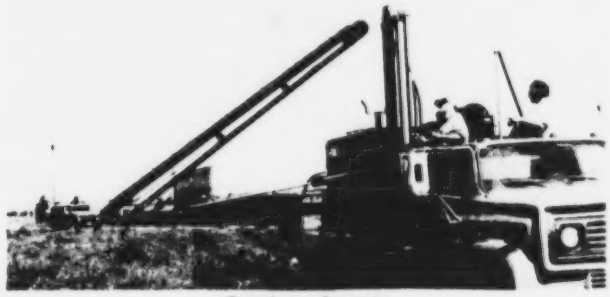


Covered boom

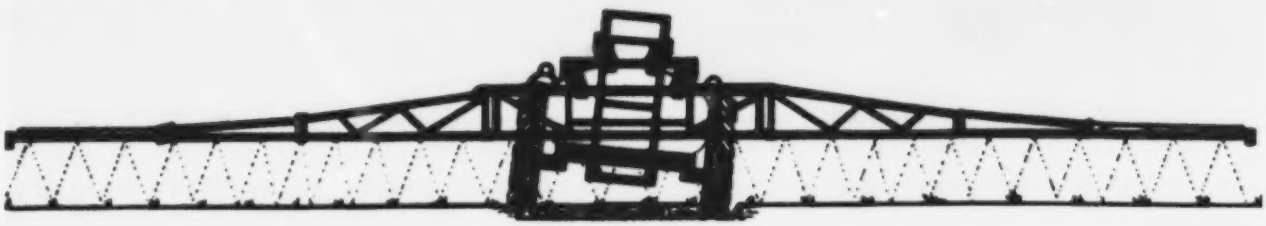
Some possible disadvantages are:

- operator cannot see the nozzles in operation
- difficult to carry out nozzle tip calibration
- difficult to clean underneath some models
- possible buildup and subsequent run off of herbicides causing crop damage.

Although there are electronic nozzle monitors available that warn the operator when plugging occurs the monitors cannot indicate if the spray pattern is distorted.



Contour boom



Self-stabilizing boom

Articulating Roadside Sprayer Boom

Regardless of roadside terrain, from ditches to almost vertical banks, and all between, a contour-matic three section boom can be articulated into many convenient configurations. You can have straight angle up or down, L shape up or down, Z shape up or down or whatever you need to place the spray nozzles very close to the foliage being sprayed. A contour-matic boom is controlled hydraulically, and has a seated control position adjacent to inboard end of boom for easy and accurate operation.

These booms are available in 8 metres or 10 metres wide. An o.c. nozzle mounted on the end section can provide coverage to a maximum of 15 metres.

Boom with O.C. Nozzles

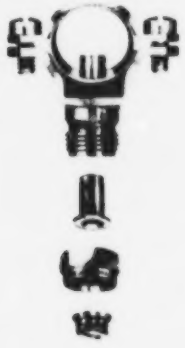
This is a hydraulic operated boom which can be controlled from inside the truck cab. One o.c. nozzle covers the portion of ditch next to the road while the second o.c. nozzle at boom end provides extended coverage into the roadside ditch up to 12 metres.

Front mount boom

NOZZLE BODIES

Wet Boom

A great majority of field sprayers used in Western Canada are classed as "wet boom" sprayers. This means that the liquid is supplied to the nozzle tips through a pipe. The nozzle tips are attached to the pipe at 50 cm spacing and this spacing is not adjustable. The older style nozzle body had a threaded cap which holds the nozzle tip in place.

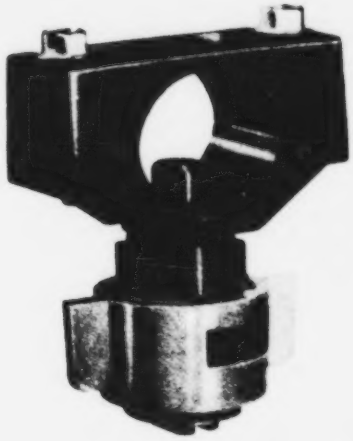


Wet boom nozzle assembly

These nozzle bodies are usually made from brass and are held in place with a stainless steel or plastic pipe clamp.

Newer designs of nozzle bodies and boom clamps are generally all manufactured from various forms of nylon regardless of the manufacturer. The new designs virtually all have a quick connect nozzle cap which only requires a quarter turn to attach or to remove the nozzle cap. This feature makes it easy to remove tips and strainers for changing or cleaning.

The newer design nozzle caps have another advantage over the threaded style. The nozzle tips fits into a slot in the cap thus becoming self aligning. This automatic aligning feature ensures that the spray patterns from adjacent nozzles do not hit each other and distort the pattern in the overlap area.



Quick connect nozzle assembly

The new design of nozzle body is also available with a diaphragm check valve to prevent nozzle dripping when the sprayer is shut off. (See nozzle check valves.)

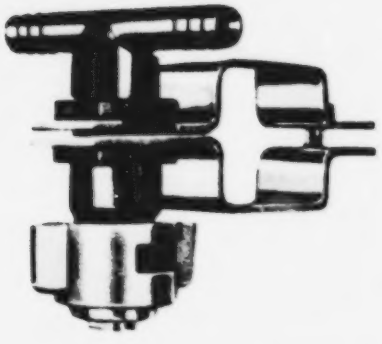
Quick connect with diaphragm

Dry Boom

Dry boom assemblies were originally designed for spraying row crops of various spacing. For this reason the nozzle spacing had to be adjustable. Pipe and round or square tubing are used to support the nozzles and the liquid is fed through hoses to the nozzles.

Row crop spraying

The new design of quick connecting nozzle caps is available for dry booms as well as for wet booms.



Dry boom quick connect nozzle assembly

NOZZLE TIPS

The successful performance of a crop chemical is highly dependent on its proper application as recommended by the chemical manufacturer. Proper selection and operation of spray nozzles are very important steps in accurate chemical application. The volume of spray passing through each nozzle plus the droplet size and spray distribution on the target can influence pest control.

Critical in controlling these three factors is the spray tip orifice. Careful craftsmanship goes into the precision machining of each orifice. Although a dealer can help in spray tip selection, the maintenance of those tips rests solely in the hands of the user.

Nozzle tips are available in brass, nylon, stainless steel, hardened-stainless steel and ceramic.

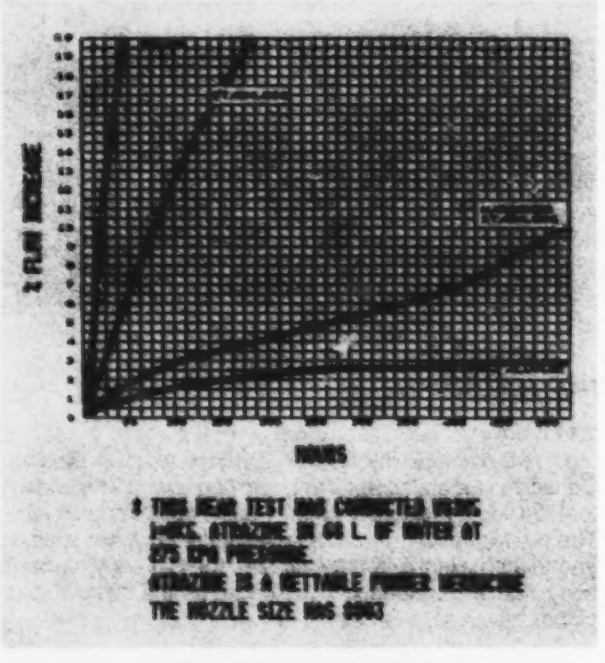
Brass tips have been the most poplar because of their availability and initial low cost but the use of stainless steel tips has been steadily increasing owing to their superior wear characteristics.

Various makes of nylon tips and plastic tips are available but little is known about their life expectancy or long term performance characteristics.

As a nozzle tip wears, the spray pattern distorts, output volume increases and the droplet characteristics change.

Recalibration may correct for output changes but cannot correct for spray pattern changes.

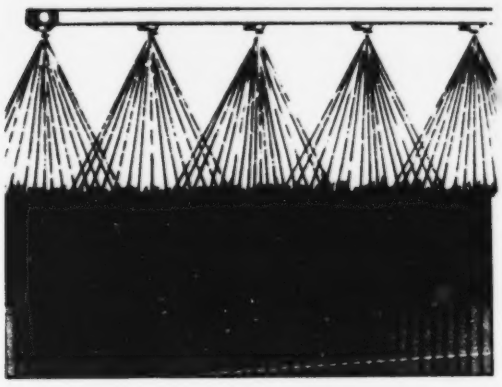
Poor spray distribution can be prevented. Selection of longer wearing tip materials or frequent replacement of tips from softer materials can eliminate misapplication caused by worn spray tips.



TeeJet nozzle wear chart

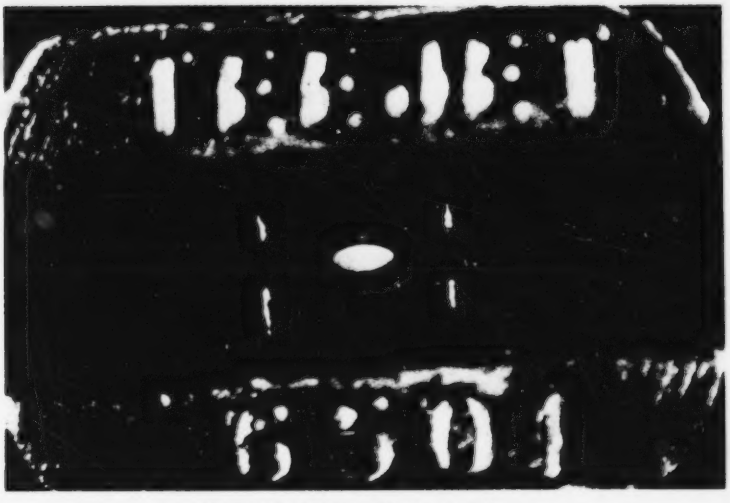
Careful cleaning of a plugged spray tip can mean the difference between a clean field and one with weed streaks. Flat spray tips have finely machined thin edges around the orifice to control the spray. Even the slightest damage from improper cleaning can cause both an increased flow rate and poor spray distribution. Be sure to use adequate strainers in your spray system to minimize plugging. If a tip does plug, only use a soft bristled brush or toothpick to clean it... never use a metal object. Use extreme care with soft tip materials. Experience has shown that even a wooden toothpick can distort the orifice.

The illustration below compares the spraying results obtained from well-maintained vs. poorly maintained spray tips.

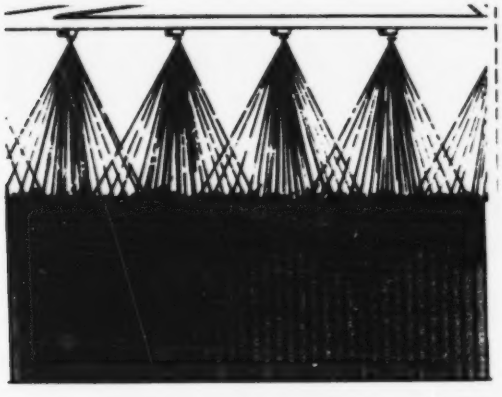


NEW SPRAY TIPS
Produce a uniform distribution when properly overlapped

New spray tips



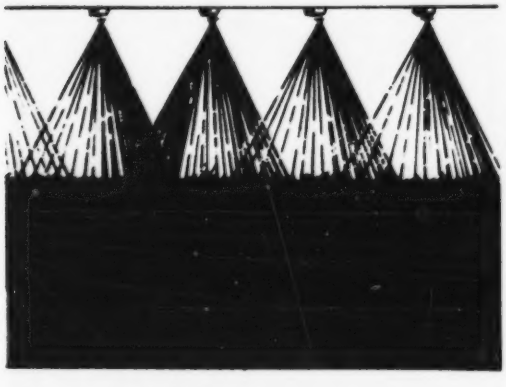
New tip: Note elliptical orifice



WORN SPRAY TIPS
Have a higher output with more spray concentrated under each tip

Worn spray tips

Worn tip



DAMAGED SPRAY TIPS
Have a very erratic output–overapplying and underapplying

Damaged spray tips

Wire damaged orifice

DROPLETS AND NOZZLE SELECTION

Selecting the best nozzle for a sprayer involves a number of factors including droplet size requirements, uniform deposit, required output and durability. These factors are further complicated by the effects of pressure, height and spacing on deposit uniformity and the effect of pressure on droplet size.

Some post-emergent herbicides require very small droplet sizes while others will tolerate somewhat larger droplets. Large droplets will produce less complete coverage and with contact type herbicides the large droplets may burn holes in the leaves of weeds without killing them or roll off the leaves and be wasted. Generally, better insect control is achieved with very small droplets as well.

The danger of spray drift increases rapidly with decreasing droplet size and any droplets less than 100 microns in diameter are prone to drifting off target and are subject to evaporation.

Actual droplet sizes

Nozzles meter the flow of the herbicide and disperse it uniformly over the target area. They also atomize the liquid into droplets small enough to provide good coverage but large enough so that wind drift is minimal.

No atomizer is capable of spraying droplets of equal size. Liquid breakup is caused by the collapse of unstable fluid sheets, jets, or ligaments, or the tearing action of air. These mechanisms produce tiny droplets of one or two microns as well as medium and large droplets extending up to several hundred microns. Finer atomization may be achieved by increasing pressures.

As viscosity of a liquid increases, large viscous forces must be overcome by the energy supplied to the nozzle. This detracts from the energy available for droplet breakup resulting in coarser atomization. With very thick materials, satisfactory atomization becomes difficult, and high operating pressures may be required.

In most cases, large droplets may be expected as nozzle capacity increases. Spray angle rating is also a factor, finer droplets being associated with larger angles. Since the mechanism of breakup is affected by nozzle construction, droplet size varies with nozzle type.

Droplet size is referred to as volume median diameter (VMD) measured in microns. This means that in any given quantity of liquid sprayed, one-half of the volume will be in droplets equal to or smaller than VMD, while the other half of the volume will be in droplets equal to or larger than VMD.

The distribution of droplet size is known for all nozzles and in many cases the greater portion of the spray is in droplets close to the VMD.

Examples:

To illustrate the effect of droplet size when changing nozzle types or spray angles, listed below are some commonly used nozzle tips. These examples assume that each nozzle is the same size (1 litre per minute at 275 kPa).

Nozzle Type	Average Droplet Size
Hollow Cone	260 microns
Flat Fan - 110° angle	300 microns
Flat Fan - 80° angle	400 microns
Flat Fan - 65° angle	475 microns
Flooding Fan	650 microns

For any given size or type of nozzle, increasing pressure reduces particle size. But this effect is much less important than the spray angle of the nozzle.

For example, at 275 kPa the 1 litre per minute 80° flat fan nozzle gave a VMD of 400 microns. Even if spray pressure were more than doubled, VMD would only be reduced to 380 microns. Whereas you could reduce droplet VMD to 300 microns simply by fitting 110° nozzles - and still spray at 275 kPa.

General Nozzle Classification

Spray Description	Droplet Size (Microns)	Nozzle	Used For
Fine Aerosols	0 - 50	Flat Fan Cone	Insecticide - Fungicide
Coarse Aerosols	50 - 100	Flat Fan Cone	Insecticide - Fungicide
Fine Sprays	100 - 250	Flat Fan Cone	Herbicide - Insecticide
Medium Sprays	250 - 500	Flat Fan	Herbicide - Insecticide
Coarse Sprays	500 - 700	Low Pressure Flat Fan	Soil applied herbicides
Very Coarse Sprays	700 - 1000	Flooding Fan Raindrop	

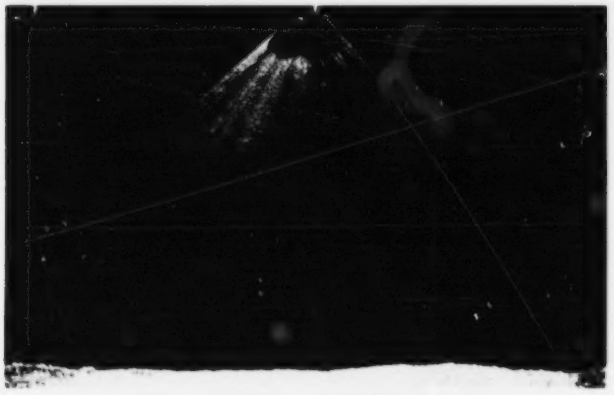
FLAT FAN NOZZLES

The ideal sprayer delivers even coverage of the whole field with a spray consisting of a large number of small droplets. Large droplets give insufficient coverage and very fine drops are subject to drift. The pattern of spray droplets on the target is created by a combination of the following three factors:

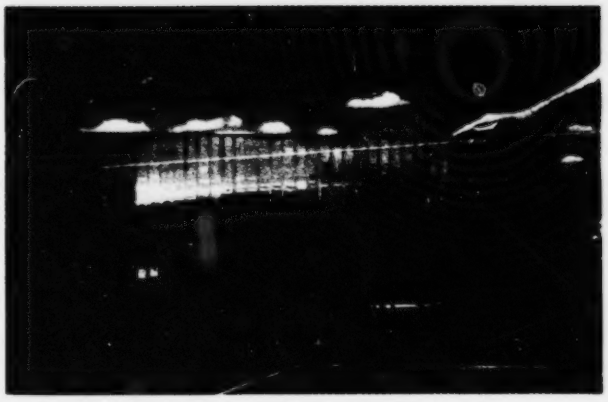
1. nozzle type,
2. pressure, and
3. boom height.

The flat fan spray tip is the most common tip used for broadcast spraying. The droplet and spray pattern characteristics produce a relatively uniform spray coverage.

The tapered flat fan nozzle used for broadcast spraying produces a pattern heavier at the centre than at the edges.

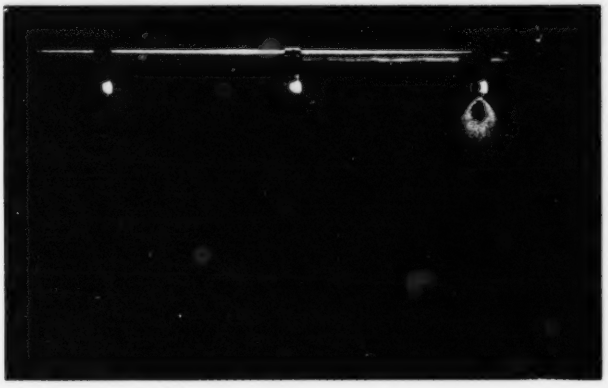


Spray pattern — flat fan nozzle



Spray collected in divided tray
Note: tapered edges

This nozzle is operated with the spray fans of adjacent nozzles overlapping 30 per cent to fill in the light areas and give a uniform pattern.



Spray pattern from two nozzles

Spray collected in divided tray
Note: Centre indicates correct overlap of two nozzles

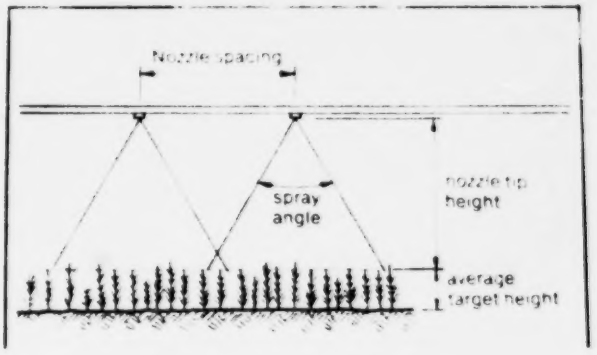
The tapered flat fan nozzle is available in a wide range of sizes and in several spray angles.

With any of the tapered flat fan nozzles, the rated spray angle is produced at only one pressure setting, i.e. 275 kPa. Increasing pressure will produce a wider pattern and smaller droplets while decreasing pressure will produce a narrower pattern and larger droplets. Since each nozzle is designed to operate over a narrow pressure range and since the nozzle spacing along the boom is fixed on most sprayers, all pattern adjustments are made by changing the height of the nozzle above the target. The target for post-emergent herbicides is the weeds, while for soil-applied herbicides, the target is the ground.

Recommended Nozzle Height

Spray Angle of Nozzle	Height (cm)
65°	50 - 60
73°	50 - 60
80°	40 - 50
110°	25 - 45

Proper height also depends on the pressure being used. Standard heights of 40 to 50 cm above the target are just a guide and are appropriate for a nozzle which produces an 80° spray angle, spaced every 50 cm along the boom and operated at 275 kPa. A more accurate way to set nozzle height is illustrated in the following diagram.

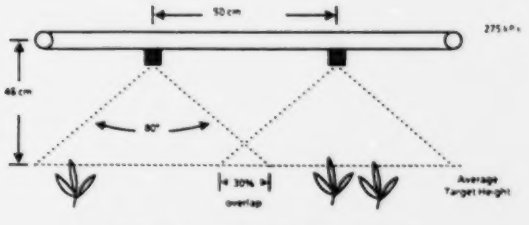


Measuring nozzle tip height

Initially, farmers used a flat fan tip that produced a 65° spray pattern. The correct height above the target for this nozzle tip was about 56 cm to allow for the correct overlap of spray patterns.

As technology progressed, spray drift was recognized as a problem and the wider-angle 80° nozzle tip became the recommended standard. This nozzle should be used at 46 cm above the target using 275 kPa pressure to provide a uniform spray pattern along the length of the boom. The lower boom height allows the spray to enter into the crop canopy more quickly, reducing the potential for drift.

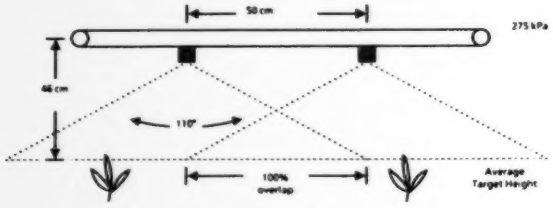
When 80° nozzles are set at the correct height above the target, the spray patterns will overlap about 30 per cent at 275 kPa pressure.



Correct settings: 80° nozzles

Under field conditions a wide variation in boom height will occur owing to weed height differences, uneven terrain and excessive travel speed. Variations in height along the same boom may vary by 10 to 15 cm causing very little or no overlap in areas where the boom is too low.

To overcome the possibility of having misses in the field, the tapered-edge flat fan nozzle with a spray angle of 110° is recommended. When the 110° nozzle tip is set at 46 cm above the target at 275 kPa with nozzle spacing of 50 cm, the spray pattern from one nozzle extends to the middle of the adjacent spray pattern. This 100 per cent overlap will allow for boom height variations to occur without creating misses between nozzle patterns.



Correct settings: 110° nozzles

TeeJet Flat Fan Nozzle Tips and Nearest Equivalents (80° + 110°)

TeeJet	Delavan	Lurmark	Hardi
11001	LF 1 - 110°	01 F 110	4110 - 10
100015	LF 1.5 - 110°	015 F 110	4110 - 12
11002	LF 2 - 110°	02 F 110	4110 - 14
11003	LF 3 - 110°	03 F 110	4110 - 16
11004	LF 4 - 110°	04 F 110	4110 - 20
11005	LF 5 - 110°	05 F 110	4110 - 24
11006	LF 6 - 110°	06 F 110	—
11008	LF 8 - 110°	08 F 110	4110 - 30
11010	LF 10 - 110°	10 F 110	—

The following nozzle chart indicates various outputs of TeeJet tips. Refer to above chart for equivalent nozzles from various manufacturers.

Flat Fan Nozzle Tip Output Chart

(Based on Spraying Water)

80° + 110° Spray Angle

TeeJet Nozzle Tip	Pressure kPa	Litres Per Minute	50 cm Nozzle Spacing Litres Per Acre						
			6km/h	7km/h	8km/h	9km/h	10km/h	11km/h	12km/h
11001	200	.32	26	22	20	17	16	14	13
	275	.38	30	26	23	20	18	16	15
	300	.39	32	27	24	21	19	17	16
110015	200	.48	39	33	29	26	23	21	20
	275	.57	46	39	35	31	28	25	23
	300	.59	48	41	36	32	29	26	24
11002	200	.65	53	44	40	34	32	28	26
	275	.76	62	52	46	40	36	32	30
	300	.79	64	54	48	42	38	34	32
11003	200	.97	79	68	59	53	47	43	40
	275	1.15	93	80	70	62	56	51	47
	300	1.18	96	82	72	64	58	52	48
11004	200	1.30	105	88	80	68	64	56	52
	275	1.52	123	104	92	80	72	64	60
	300	1.58	128	108	96	84	76	68	64
11005	200	1.61	130	111	96	87	78	71	65
	275	1.89	153	131	114	102	92	83	77
	300	1.97	159	136	119	106	95	88	80
11006	200	1.93	158	136	118	106	94	86	80
	275	2.30	185	160	140	122	112	102	94
	300	2.37	191	164	144	128	116	104	96
11008	200	2.58	209	176	160	136	128	112	104
	275	3.04	246	208	184	160	144	128	120
	300	3.16	255	216	192	168	152	136	128
11010	200	3.22	261	222	192	174	156	142	130
	275	3.78	306	262	228	204	184	166	144
	300	3.95	320	272	238	212	190	176	160

Extended Range Flat Fan Nozzle Output Chart

80° + 110° Spray Angle

Nozzle Tip Number	Pressure kPa	Litres Per Minute	Litres per Acre @ 50 cm Spacing				
			8km/h	9km/h	10km/h	11km/h	12km/h
XR11001	100 275	.23 .38	13 23	12 20	10 18	9 17	8 15
XR110015	100 275	.35 .56	21 34	19 30	17 27	15 25	14 23
XR11002	100 275	.44 .76	27 46	24 41	22 37	20 33	18 31
XR11003	100 275	.68 1.12	41 68	36 60	33 54	30 49	27 45
XR11004	100 275	.92 1.50	56 91	50 81	45 73	41 66	37 61
XR11005	100 275	1.18 1.89	72 115	64 102	58 92	52 84	48 77
XR11006	100 275	1.39 2.28	84 138	75 123	67 110	61 100	56 92
XR11008	100 275	1.86 3.01	113 183	100 163	90 146	82 133	75 122

Flat Fan Extended Range Tips (XR TeeJet)

The XR nozzle tip produces a tapered edge spray pattern and is designed to operate over an extended range of pressures to accommodate a variety of conditions. At the operating pressure of 100 kPa this nozzle produces larger droplets which provide drift control and are especially suitable for soil applied herbicides. At an operating pressure of 275 kPa smaller droplets are produced similar to the standard flat fan nozzle tip. Pressures above 300 kPa are recommended only for insecticide or fungicide application.

EVEN FAN NOZZLES

The even spray tip is identical to the flat spray tip except it does not produce a tapered edge pattern. As a result, this tip is not used for broadcast spraying owing to excessive spray coverage if overlap should occur. It is primarily used to band-spray row crops.

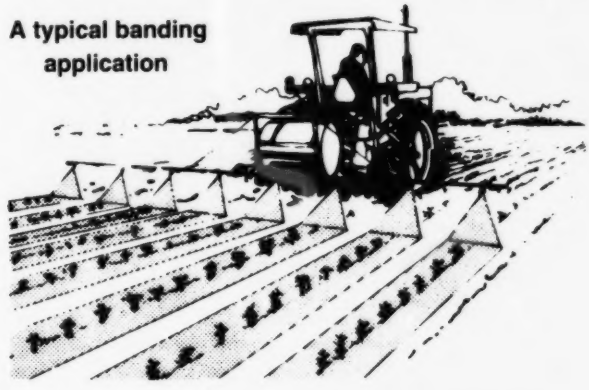
The even spray tips are identified by the letter "E" in the tip designation (e.g. 8001E). The even spray tips have the same output as a flat spray tip with the same volume designation.

However, when band spraying occurs, any nozzle tip will apply various volumes per acre depending on row spacing and the width of the band actually sprayed. This means that any nozzle will give a much higher volume per acre rate on the area actually sprayed in the band than the nozzle would if it were used with the same spacing in a broadcast application.

As chemical rates are given in broadcast application rates and volumes, the following formula will allow calculating the litres per acre for the total field in a band application rate.

$$\frac{\text{Band Width}}{\text{Nozzle Spacing}} \times \text{L/acre (broadcast rate)} = \text{L/acre (band rate)}$$

A typical banding application



Example: Band width 35 cm — Row spacing 100 cm and broadcast rate to be 50 L/acre.

Calculate: $\frac{35}{100} \times 50 = 17.5$ L/acre

To pick the correct nozzle tip to use in the above example the following formula will establish the nozzle output in litres per minute that is required to produce 17.5 litres per acre at the desired speed of travel. In this example the desired speed of travel is 12 kmh.

The number of field acres one tank load will cover will be based on 17.5 litres of solution per acre. The amount of pesticide to use can then be determined.

$$\frac{\text{L/acre (band rate)} \times \text{kmh}}{24282} \times \text{Band Width (cm)} = \_\_\_\_ \text{ L/min}$$

$$\frac{17.5 \times 12}{24282} \times 35 \text{ cm} = 0.30 \text{ L/min}$$

From the Even Fan Nozzle Tip Output Chart that follows, the nozzle 8001E would be chosen for this application. Nozzle calibration at a pressure between 150 and 200 kPa will give the desired 0.30 litres per minute.

Even Fan Nozzle Tip Output

TeeJet Nozzle Tip	Pressure	Litres Per Minute
8001 E	150 200 275	.28 .32 .38
80015 E	150 200 275	.42 .48 .57
8002 E	150 200 275	.56 .65 .76
8003 E	150 200 275	.84 .97 1.13
8004 E	150 200 275	1.12 1.29 1.51
8005 E	150 200 275	1.40 1.61 1.89
8006 E	150 200 275	1.67 1.93 2.27
8008 E	150 200 275	2.23 2.58 3.02

The width of the band required can be controlled by adjusting the nozzle height above the target. Even fan nozzle tips are available with spray pattern angles of 40°, 80° and 95°. The following chart indicates the approximate band width achieved at various heights with the various spray angles.

Band Width (cm)	Approximate Nozzle Height (cm) 40°	80°	95°
20	25	13	10
25	30	15	13
30	35	18	15
35	43	20	18
40	48	24	21

FLOODING FAN NOZZLE

This tip is a variation of the even edge design with the spray angle extended at 110° - 145°. The spray produced is not as uniform as the flat spray. It does, however, result in less drift. Normally, flooding nozzles are spaced 100 cm apart with a boom height that results in little or no overlap.

The flooding tips are not recommended for any herbicide application in a crop situation because of the erratic spray pattern produced.

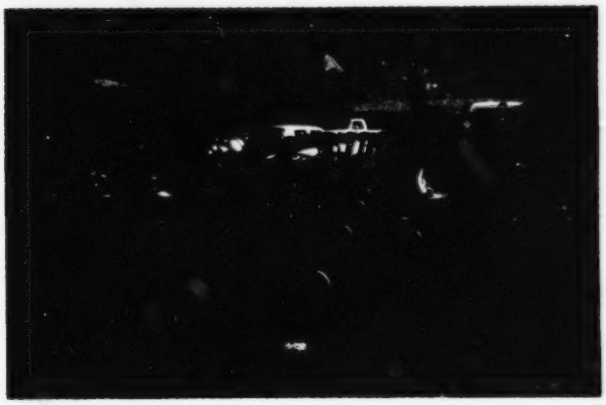
Flooding fan spray pattern

Flooding Fan Nozzle Tip Output Chart
(100 cm Spacing)

Nozzle No.		Pressure	Litres Per	Litres per Acre @ 50 cm Spacing			
TeeJet	Delavan	kPa	Minute	6km/h	8km/h	9km/h	10km/h
TK .75	D 75	250 275	.54 .57	22 23	17 18	15 16	13 14
TK 1	D 1	250 275	.72 .78	29 31	22 23	19 21	17 19
TK 1.5	D 1.5	250 275	1.08 1.13	44 46	33 35	29 31	26 28
TK 2	D 2	250 275	1.44 1.51	58 61	44 46	39 41	35 37
TK 2.5	D 2.5	250 275	1.80 1.89	73 77	55 58	49 51	44 46
TK 3	D 3	250 275	2.16 2.26	89 93	67 70	59 62	53 56

OFF-CENTRE NOZZLE (O.C.)

Off-centre nozzle tips are usually referred to as boom-end nozzles. Most field sprayers come equipped with these nozzles and have a shut-off valve provided. O.C. nozzles should not be used for overall herbicide application in crop as the spray pattern is not very uniform. These nozzles should be used only on headlands, slough areas and fencelines to provide extended coverage where the boom nozzles cannot reach. The coverage extends from one to three metres depending on nozzle size, pressure and wind conditions. Drift can be very pronounced with these nozzles.



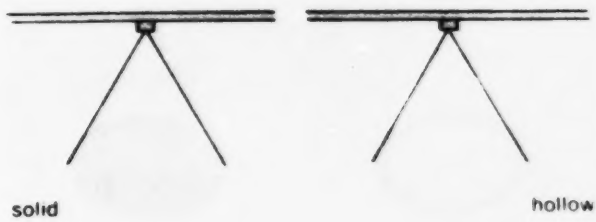
Boom-end nozzle

Large capacity o.c. nozzles are designed to provide a boomless spray and are used for spraying roadside ditches, pastures and other areas too rough for boom sprayers or where there are many obstacles such as brush and fences. These nozzles provide coverage up to 10 metres depending on nozzle size, pressure and wind conditions.

Large O.C. nozzle

A combination of two large o.c. nozzles mounted together form a single unit called a boomjet nozzle for spraying in rough pasture and rangeland. This system can be mounted behind a truck, tractor or trailer sprayer and can cover up to 18 metres.

Boomjet boomless spray nozzles



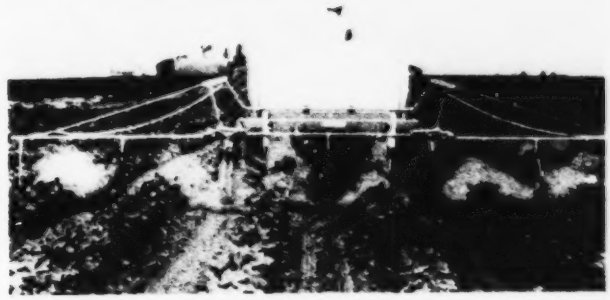
Cone nozzles

CONE NOZZLES

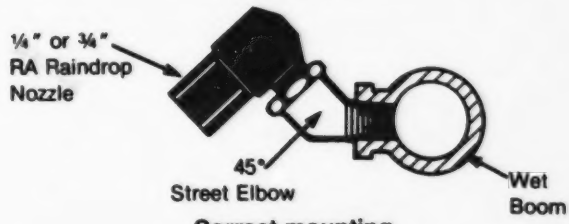
Hollow cone and solid cone nozzles are popular for row-crop spraying. They are used on spray booms and with handguns. The spray angle may be from 30° to 120°. Hollow cone nozzles generally produce a finer, more uniform spray than the solid cone type.

These nozzles are useful for applying insecticides but are not generally used for broadcast application of herbicides as a uniform spray pattern cannot be achieved in the overlap area between two nozzles on a boom.

Example of cone nozzle use for applying insecticides.



Cone nozzle use



Correct mounting

O.C. Nozzle Output Chart
(Small)

¼ T Off-Centre Nozzle No.	Pressure kPa	Litres Per Minute	Litres Per Acre Spraying Height 45 cm				
			Width in (cm)	6km/h	8km/h	9km/h	10km/h
O.C. 02	200 300	.65 .79	172 177	15 18	11 14	10 12	9 11
O.C. 03	200 300	.97 1.18	195 203	20 23	15 17	13 15	12 14
O.C. 04	200 300	1.29 1.58	231 236	22 27	17 20	15 18	13 16
O.C. 06	200 300	1.93 2.37	251 256	31 38	23 29	21 25	19 23
O.C. 08	200 300	2.58 3.16	254 259	41 49	31 37	27 33	25 29
O.C. 12	200 300	3.87 4.74	259 264	60 72	45 54	40 48	36 43
O.C. 16	200 300	5.16 6.32	335 350	62 72	47 54	41 48	37 43

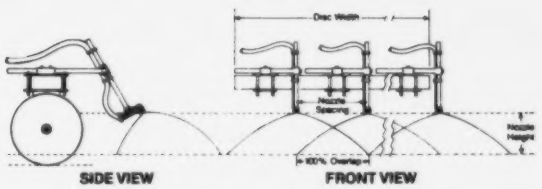
O.C. Nozzle Output Chart
(Large)

¾ T Off-Centre Nozzle No.	Pressure kPa	Litres Per Minute	Litres Per Acre Spraying Height 90 cm				
			Width in metres	6km/h	8km/h	9km/h	10km/h
O.C. 10	200 300	3.20 3.95	5.4 5.6	19 21	17 19	15 17	13 14
O.C. 20	200 300	6.45 7.90	7.1 7.4	28 32	25 28	22 26	19 21
O.C. 40	200 300	12.8 15.8	7.9 8.2	49 58	44 52	39 46	33 39
O.C. 80	200 300	25.8 31.6	8.8 9.1	89 105	79 93	71 84	59 70
O.C. 150	200 300	48.3 59.2	9.3 9.6	158 186	140 165	126 149	105 124
O.C. 300	200 300	96.7 118.0	9.7 10.0	303 364	269 324	242 291	202 243

RAINDROP NOZZLES

Raindrop nozzles produce large droplets which can significantly reduce spray drift. In order to get good patterns from a raindrop nozzle, they must be mounted at 45° to the horizontal, rather than straight down, as with other nozzle types. The very large droplets produced will not provide adequate coverage with foliar-applied post-emergence herbicides, so they are generally used for soil-applied herbicides. They are also quite useful for specialized purposes such as roadside spraying, aerial application, and in urban areas to avoid drift problems.

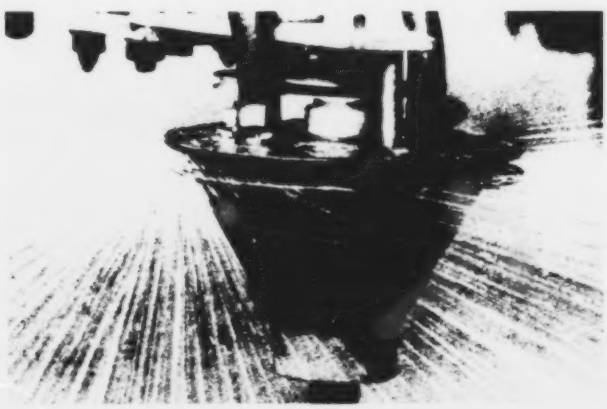
For Spraying While Incorporating



Raindrops on incorporating implement

Raindrop Nozzle Output Chart

Nozzle Number	Pressure kPa	Litres Per Minute	Litres Per Acre					
			50 cm Spacing			100 cm Spacing		
			6km/h	8km/h	10km/h	6km/h	8km/h	10km/h
RA 2	200 275	.64 .76	52 61	39 46	31 37	26 30.5	19.5 23	15.5 18.5
RA 4	200 275	1.29 1.51	104 122	78 92	63 73	52 61	39 46	31.5 36.5
RA 5	200 275	1.61 1.89	130 153	98 115	78 92	65 76.5	49 57.5	39 46
RA 6	200 275	1.93 2.27	157 183	117 138	94 110	78.5 91.5	58.5 69	47 55
RA 8	200 275	2.58 3.02	209 245	157 183	125 147	104.5 122.5	78.5 91.5	62.5 73.5
RA 10	200 275	3.22 3.78	261 306	195 229	157 183	130.5 153	97.5 114.5	78.5 91.5
RA 15	200 275	4.84 5.67	397 461	297 346	238 277	198.5 230.5	148.5 173	119 138.5
RA 20	200 275	6.45 7.56	— —	— —	— —	260 305	195 229	156 183
RA 25	200 275	8.06 9.45	— —	— —	— —	325 383	244 287	195 230



Controlled droplet applicator

CONTROLLED DROPLET APPLICATOR

An electrically driven spinning disc nozzle uses centrifugal force to distribute uniform sized droplets in a 1.8 m circular pattern. Droplet size is controlled by rotational speed and the size of the orifice in the check valve. The unit is belt-driven off a 2-ampere motor powered by a 12-volt battery.

Advantages and Disadvantages As Compared to Standard Nozzles

Advantages:

- — produces a narrow spectrum of droplet sizes with virtually no fines that could evaporate and no large droplets that would run off leaf surfaces.
- — applies low water volumes thus increasing field efficiency.

Disadvantages:

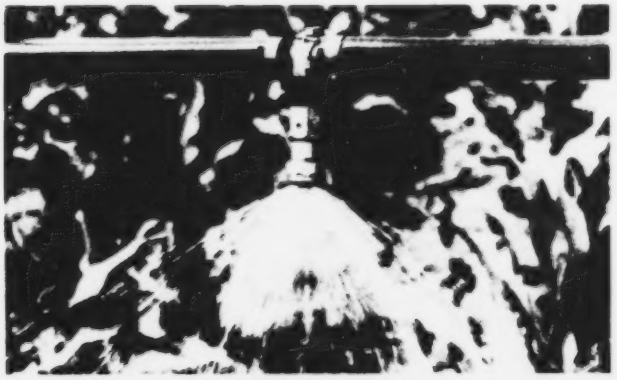
- — initial high cost.
- — not capable of applying all pesticide formulations such as wettable powders.
- — more complicated mechanical and electronic components and more moving parts subject to wear.
- — depending on the mixture being sprayed the droplets produced will vary in size at a given disc speed and will be carried a different distance from the disc. With various registered mixes in use the

high concentration of chemicals in low volumes of water create many unknowns insofar as the reaction of surfactants and adjuvants as they relate to crop tolerance, etc.

— label recommendations presently do not allow for low volume application with the exception of aerial application.

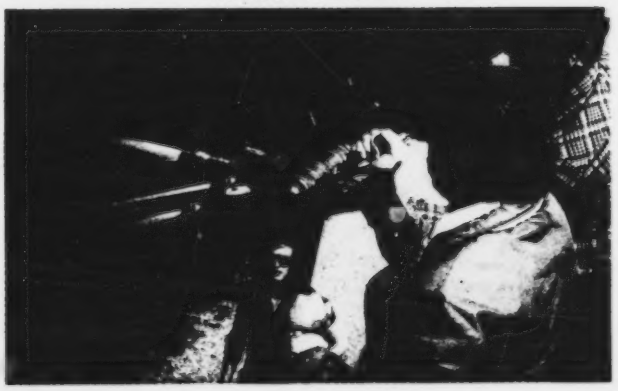
ACCUTROL NOZZLES

These nozzles are designed for industrial uses such as spraying roadsides or other rights-of-way. Accutrol nozzles produce large droplets to reduce drift and are designed to be used in combination with a spray adjuvant. The nozzle draws in air and mixes it with the spray to form a milky mixture resembling foam that is visible to the operator. Large V-nozzles are used on a boom and produce a fan shaped spray pattern. Other types of accutrol nozzles are designed for use as a boomless spray system. These can also be adapted to handguns.



Accutrol V-nozzle

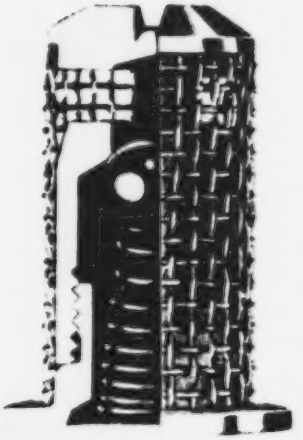
Accutrol F-nozzle



Accutrol system

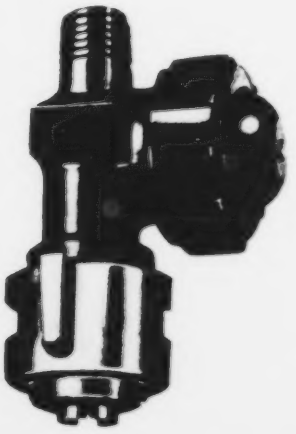
NOZZLE CHECK VALVES

Nozzle check valves can be used to effectively eliminate nozzle dripping when boom pressure has stopped. The valves also provide spray without hesitation, when flow is reapplied. This is accomplished by means of a diaphragm check valve or a spring-loaded ball-check which stops flow through the nozzle when the pressure drops to a certain level.



Ball check valve

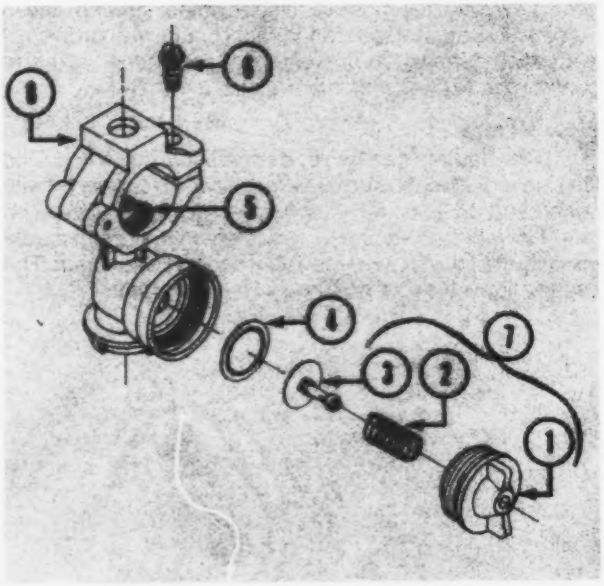
Spraying pressure must be increased by 35 kPa to compensate for a pressure drop through the ball check strainer.



Diaphragm check valve

Diaphragm Check Valves

These types of check valves were originally designed for use in aerial spraying but they are used on ground rigs as well. Maximum operating pressures should not exceed 900 kPa. The spring-backed diaphragm valve assures dependable shut off with no pressure drop at standard agricultural spray volumes.



Diaphragm check nozzle body

Ref. No.	Description
1	Spring Module Cap
2	Spring
3	Pressure Pad
4	Viton® Diaphragm
5	Stem Seal
6	Screw
7	Spring Module Assembly (Ref. #1-3)
8	½" Bridge piece
	¾" Bridge piece

Handgun

HANDGUNS

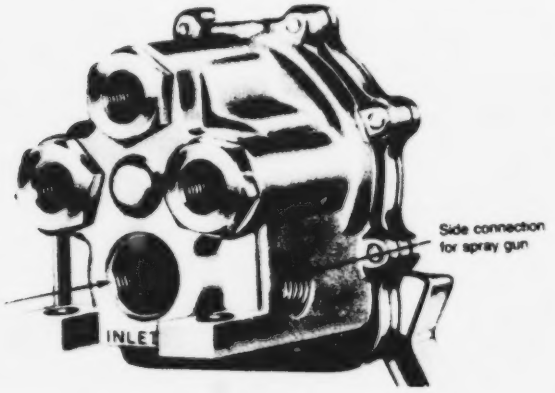
For jobs that are too big for self-contained hand sprayers, or where large amounts of solution are required to wet the foliage, the handgun is a convenient accessory to the field or truck mounted sprayer.

The handgun consists of the gun itself and a length of hose. It is used during field spraying to treat patches of weeds in locations inaccessible to the tractor and sprayer, or to spray areas where weeds or brush are too high to go over with the sprayer itself. Handguns may be added easily to a standard field sprayer. They will be invaluable for treating cattle, for spraying insects in shelterbelts, and for general clean-up work.

Hooking Up A Handgun

A minimum amount of plumbing is required to hook up a handgun. Once the connection to the outlet line is made, it may be permanently left in place.

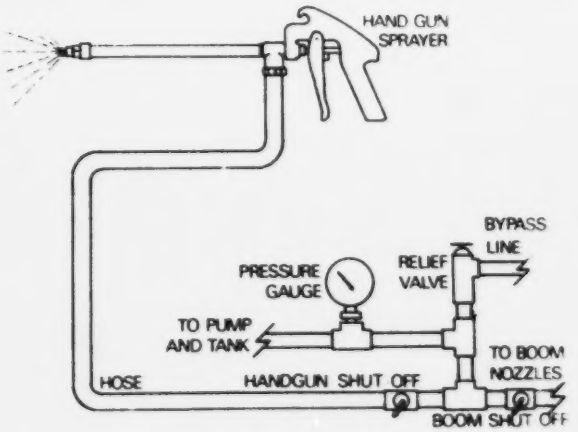
1. Installation should be made in a line between the pump and the boom. If a selector valve is present, the installation can be made right at the valve.



Selector valve

If other types of valves are used the connection should be between the valve and one boom section.

2. A tee is installed at some convenient point between the pump and boom.
3. A nipple is installed in the tee leading to a shut-off valve.
4. A nipple is installed on the other side of the shut-off valve, leading to a hose connector.
5. A hose, at least 8 m in length and leading to the handgun, is hooked into the system at the hose connector.
6. To complete the hook up, a shut-off valve should be installed between the tee and the boom.



Hooking up a handgun

How To Use A Handgun

Controlling weeds with a handgun requires a relatively high volume of spray solution. It is essential that weed foliage be thoroughly covered to the point of run-off.

Output from a handgun depends upon:
1. Size of orifice disc in handgun.
2. The pressure at the gun.
3. The spraying habits of the gun operator. The whole operation is completely manual so the lay down depends upon how long the operator dwells on a weed patch.

Handgun Orifice Disc Output Capacity

Disc Orifice Size	Capacity L/min at kPa Pressure 500 kPa	1000	1500	2500
4	2.74	3.87	4.74	6.12
5	4.10	5.80	7.10	9.17
6	5.70	8.06	9.87	12.70
7	7.52	10.60	13.0	16.80
8	9.80	13.90	17.0	21.90

Three precautions are suggested when using a handgun:
1. Thoroughly clean the gun between jobs since the hose can contain a substantial amount of pesticide mixture.
2. Precise calibration is very difficult, so handguns should be used for applications where very accurate rates are not required. For example, herbicides are generally applied with a handgun by mixing a very dilute solution and applying to the point of runoff.
3. Pressure and water volume are the factors that allow us to reach the target. For water particles to carry they must have mass, so there are limits to the maximum pressure used to increase the throw or carry of a water stream.
   Always use a large enough hose with nozzle disc to permit using as much pump capacity as possible.

CHEMICAL INJECTORS

Advantages
- — do not contaminate sprayer tank — less cleaning
- — no agitation problems
- — correct chemical rates regardless of spray volume
- — no problem with chemical compatibility in mixes
- — if an operation must stop because of weather or breakdown there is no concern about leaving a chemical solution to settle out in the tank
- — no leftover chemical solution to dispose of.

A few chemical injection systems have appeared in Alberta lately. There were problems encountered with varying viscosities of chemicals causing different flow rates when changes in temperature of the chemicals occurred. The injection system was also not integrated into the sprayer system to allow for automatic rate adjustment when speed changes occurred in the field. PAMI is currently testing an improved version of an injection system.

A more recent arrival operates with a positive displacement piston pump, which may overcome problems encountered with chemical viscosity. The positive displacement pump is ground driven from a trailing wheel on the sprayer. Once the correct setting is made for the desired flow rate the positive displacement ground driven pump will keep the application rate constant regardless of the speed of travel. At present there are no test results to confirm the accuracy of this system.

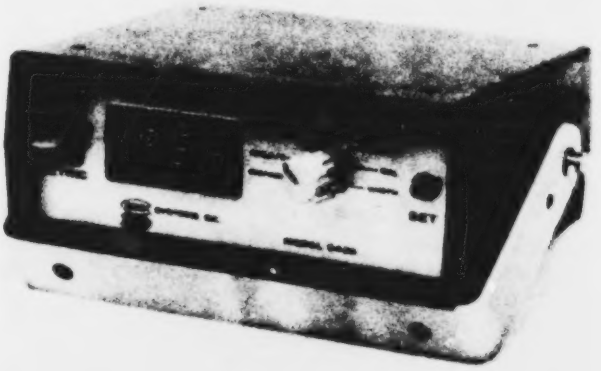
Flow Meters

Flow meters can be used to measure liquid flow. The flow is a digital readout in litres which can be correlated with speed and distance travelled to determine the application rate. Flow meters should be mounted on the line to measure only the liquid flow to the spray booms or handgun. The bypass flow must not go through the flow meter.

Flow meter

Sprayer Monitors

Electronic calibration is now available from several companies. This is one of the most significant advances in spraying technology. With the use of electronic circuitry, it is possible to correlate liquid flow out of the booms with the forward speed of travel to display the application rate as a continual digital readout. These devices enable selection of the proper application rate and the operator simply adjusts the forward speed until correct application is achieved as indicated on the dial. Liquid flow is continuously measured, so any significant change in the spraying system, such as excessive plugging, pump or regulator malfunction, or excessive leakage will show up instantly on the monitor.



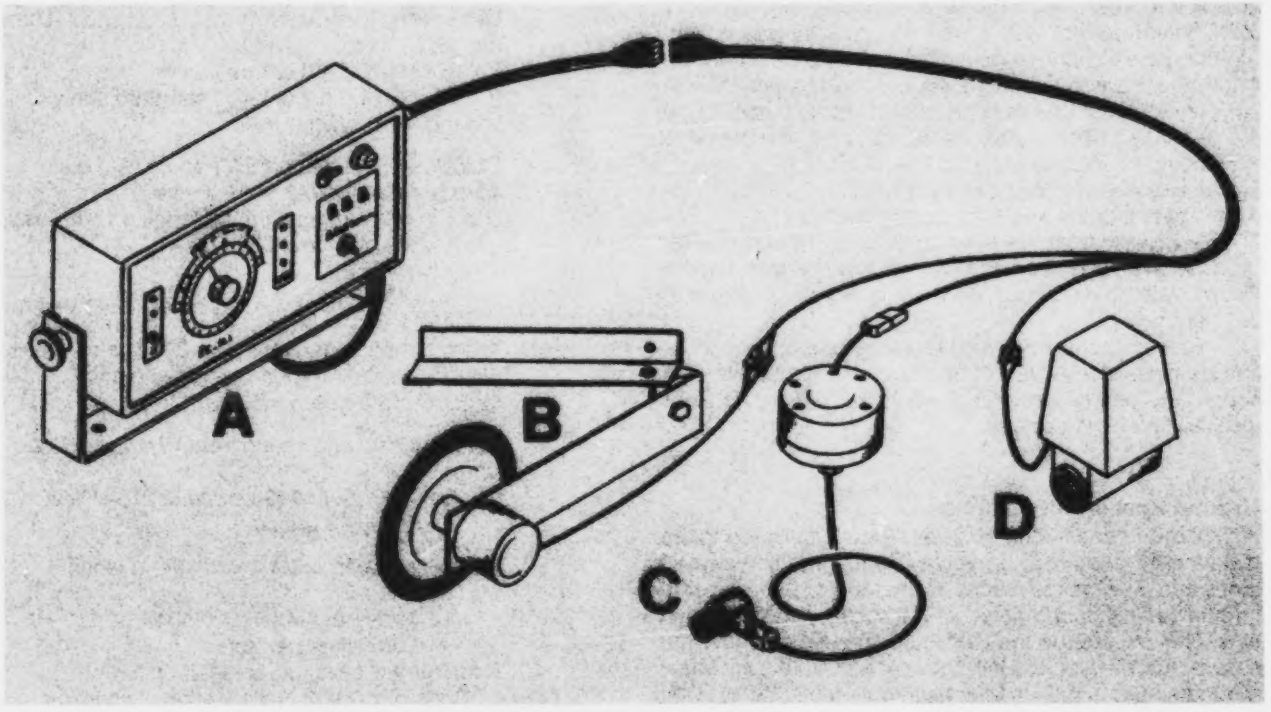
Sprayer monitor

Sprayer Controllers

An automatic sprayer control simplifies your liquid application job by automatically maintaining the same application rate within recommended speed ranges. The system adjusts the liquid flow so the application rate remains uniform throughout the field. The complete system is composed of the four components listed below. The accurate operation of the system is based on having accurate flowing nozzles or tips. Replace tips on a regular basis to assure the system will maintain accurate rate control.

A. Console. The console monitors ground speed and spraying pressure. When the controls are set to the desired speed and rate, an analog computer compares actual ground speed to the preset desired rate and speed and adjusts the spraying pressure to maintain the desired output.
B. Speed Sensor. This sensor is mounted on a non-driven sprayer or tractor wheel; it measures ground speed.
C. Pressure Sensor. This electronic pressure transducer is connected to the nozzle to monitor spraying pressure. The electrical signal is then used to modulate the pressure regulator.
D. Pressure Regulator. This butterfly valve is powered by a gear motor and controls pressure.

It is important to have unrestricted flow through the line, therefore the pump capacity should match the hose diameter size. Too small a hose size will cause either a pressure drop or ineffective operation of the sprayer control system.



Sprayer monitor — controller

SPRAYER OPERATION

Preliminary planning begins with the decision to apply a herbicide and to chose the particular chemical that will be used. You then have three more decisions to make:

— Which speed of travel will you use to apply the chemical? This will depend on the kind of equipment you will use and the roughness of the field you want to spray.
— Which nozzle tips should you use? You pick the nozzle size that will apply the required volume at the speed you wish to travel using the recommended pressure.
— How much chemical should you apply? The chemical label shows the amount of herbicide to apply.

SPRAYER CALIBRATION

Accurate calibration of spraying equipment is an important aspect of chemical usage. An application of more than the recommended rate is wasteful and may damage the crop; applications of less than the recommended rate may be ineffective; again wasteful.

Preliminary Adjustments And Settings

Preliminary adjustments and settings include all of the adjustments that are made when the machine is being prepared for use.

Before starting to spray, check wheel bearings and tire inflation, and lubricate moving parts as recommended in the operator's manual. Tighten any loose bolts or nuts.

Install tips, screens, check valves, and any other equipment that has been selected. Be sure fan nozzles are aligned so patterns overlap slightly but do not interfere with each other.

Boom height depends on the spray angle of the tips selected. Set the boom at the required height and level it from side to side. Improper height causes non-uniform application.

Nozzle Calibration

The output of individual nozzles must be within 5 per cent of the average nozzle output if an even volume is to be applied over the width of the sprayer. Nozzles with outputs either above or below this value must be cleaned and or replaced.

1. Check and clean all nozzles, screens and filters.
2. Check pressure gauge for accuracy.
3. Check boom pressure with an accurate gauge, and compare to sprayer gauge (both should be identical).
4. With sprayer operating at the desired spraying (boom) pressure, using water only, collect nozzle output for 30 seconds. If ball check valves are used, the pressure should be increased by 35 kPa.
5. Measure and record collected amount.
6. Repeat steps 4 and 5 for all nozzles.
7. Replace nozzles that have an output 5 per cent greater than average; clean and recheck nozzles with outputs of less than 5 per cent of average (replace if necessary).

Brass nozzles should be recalibrated every 25 hours and stainless steel nozzles should be recalibrated every 50 hours. The use of wettable powders will require frequent recalibration of all nozzles.

Ground Speed Determination

Ground speed can be determined by measuring the distance travelled in one minute. Repeat the test several times and average the results. Remember to use the same throttle setting (tachometer) and transmission gear each time. Run the tests in the field to be sprayed and have the sprayer tank half-full. Soil surface and load can affect ground speed and a half-full tank represents the average load. The sprayer must be at full speed before starting the test run.

	Seconds to Drive	
Speed in km/h	**60 metres**	**90 metres**
5.0	45	68
5.5	39	58
6.0	37	54
6.5	34	51
7.0	30	45
8.0	27	41
9.0	24	36
10.0	23	34
11.0	19	29
12.0	18	27
13.0	17	25
14.0	15	23
16.0	14	20

Sample Nozzle Chart

Nozzle	Pressure kPa	Litres Per Min.	Litres per Acre 50 cm Spacing			
			6km/h	8km/h	9km/h	10km/h
8001 or 11001	275	.38	30	22	20	18
80015 or 110015	275	.57	45	34	30	27
8002 or 11002	275	.76	60	45	40	36

Calibration Procedure I — LITRES PER ACRE

— Field Size _____ Acres
EXAMPLE: 40 acres

— Sprayer Tank Capacity _____ Litres
EXAMPLE: 1400 litres

— Determine Spray Volume _____ Litres Per Acre
EXAMPLE: 40 L/acre
(from label - L/ha x 0.4047) standard spray volume is 40 L/acre

— Calculate spray required for entire field e.g.
40 acres x 40 L/acre = 1600 litres
Note: In this example the tank holds 1400 litres. It will only cover 35 acres.
EXAMPLE:

$$\frac{\text{1400 Litres}}{\text{40 Litres per Acre}} = \text{35 acres @ 40 L/acre}$$

Therefore a second tank with 200 litres of solution will be needed to complete the remaining 5 acres.

— Select nozzle and speed from "Sample Nozzle Chart"
EXAMPLE: 11002 nozzle at 275 kPa at 9 kmh = 40 L/acre

— Add chemical to water in tank (from label)
EXAMPLE:
1.5 litres per hectare x 0.4047
= 0.607 litres per acre
A tankful will cover 35 acres, therefore multiply 35 x 0.607 = 21.2 litres of chemical
The second tank to complete the field will require:
5 x 0.607 = 3 litres of chemical

— Set pressure at 275 kPa. Drive at 9 kmh. At this speed it takes 36 seconds to travel 90 metres.

Calibration Procedure II

This method of calibration is provided as an alternative.

After the nozzles have been individually calibrated and matched the following steps should be completed.

1. Fill the sprayer tank with water.
2. Operate the sprayer at the desired pressure for 15 minutes.
3. Measure the number of litres needed to refill the tank.
4. Refer to the following table to obtain the correct speed in km/h.

NOTE: Table is correct only for the nozzle spacing indicated.

EXAMPLE: Twenty-six nozzles, 40 L/ac desired, 260 litres needed to refill sprayer. Correct speed — 8 km/h.

CALIBRATION TABLE

To Apply 20 L/ac	To Apply 40 L/ac	NUMBER OF NOZZLES — 50 cm SPACINGS											
LITRES/15 MINUTES		24	25	26	30	32	33	34	35	36	40	48	49
		kilometres per hour											
90	180	6.0	5.8	5.5	4.8	—	—	—	—	—	—	—	—
100	200	6.7	6.4	6.2	5.3	5.0	4.8	—	—	—	—	—	—
110	220	7.3	7.0	6.8	5.9	5.5	5.3	5.2	5.0	4.9	—	—	—
120	240	8.0	7.7	7.4	6.4	6.0	5.8	5.6	5.5	5.3	4.8	—	—
130	260	8.7	8.3	8.0	6.9	6.5	6.3	6.1	5.9	5.8	5.2	—	—
140	280	9.3	9.0	8.6	7.5	7.0	6.8	6.6	6.4	6.2	5.6	—	—
150	300	10.0	9.6	9.2	8.0	7.5	7.3	7.1	6.9	6.7	6.0	5.0	4.9
160	320	10.7	10.2	9.8	8.5	8.0	7.7	7.5	7.3	7.1	6.4	5.3	5.2
170	340	11.3	10.9	10.5	9.1	8.5	8.2	8.0	7.8	7.6	6.8	5.7	5.5
180	360	12.0	11.5	11.1	9.6	9.0	8.7	8.5	8.2	8.0	7.2	6.0	5.9
190	380	—	—	11.7	10.1	9.5	9.2	8.9	8.7	8.4	7.6	6.3	6.2
200	400	—	—	—	10.7	10.1	9.7	9.4	9.2	8.9	8.0	6.7	6.5
210	420	—	—	—	11.2	10.5	10.2	9.9	9.6	9.3	8.4	7.0	6.9
220	440	—	—	—	11.7	11.0	10.7	10.4	10.1	9.8	8.8	7.3	7.2
230	460	—	—	—	—	11.5	11.1	10.8	10.5	10.2	9.2	7.7	7.5
240	480	—	—	—	—	12.0	11.6	11.3	11.0	10.7	9.6	8.0	7.9
250	500	—	—	—	—	—	—	11.8	11.4	11.1	10.0	8.3	8.2
260	520	—	—	—	—	—	—	—	11.9	11.6	10.4	8.7	8.5
270	540	—	—	—	—	—	—	—	—	12.0	10.8	9.0	8.8
280	560	—	—	—	—	—	—	—	—	—	11.2	9.3	9.1
290	580	—	—	—	—	—	—	—	—	—	11.6	9.7	9.5
300	600	—	—	—	—	—	—	—	—	—	12.0	10.0	9.8

Calibration and Application Guide

The following guide is provided to help plan a spraying operation. Included is a formula that can be used to determine spray volume if nozzle output charts are not available.

A. Field description _____

B. Field size _____ acres

C. Crop _____

D. Weeds to control _____

E. Herbicide to use _____

F. Herbicide rate _____ litres or _____ kilograms per acre

G. Spray volume needed _____ litres per acre

H. Total herbicide needed (multiply B x F) _____

I. Sprayer tank size _____ litres

J. Nozzle No. _____

Pressure _____ kPa = _____ litres per acre

Nozzle output _____ L per min

Speed _____ km per hr

K. One tankful will cover (divide I/J) _____ acres

L. Herbicide per tankful (multiply F x K) = _____ L or kg

Formula:

$$\frac{24282 \times \text{L/min (per nozzle)}}{\text{km/h} \times \text{W* (cm)}} = \text{litres/acre}$$

*W — Nozzle spacing (in boom spraying) or spray swath (in boomless spraying) ... in centimetres.

CHANGING RATES

Suppose the application rate you determined is unacceptable. How do you change it? You can make three kinds of changes.

Pressure influences flow rate, as discussed earlier. Lower the pressure and you lower the flow rate. Raise pressure and flow rate is increased. However, this is not a good method to use. You must increase pressure by a factor of 4 to double the flow. High pressure increases the number of small spray particles which can cause drift problems. Pressure too high or too low also distorts nozzle distribution patterns.

Nozzle size can be changed to alter the application rate. Use larger tips to increase the rate. The main advantage of this method over changing the pressure is that using the proper pressure helps to control drift and maintain the nozzle pattern. This is usually the preferred method of changing application rates.

Speed changes alter application rate. This method is practical for small changes in application rate. However, excessive speeds should be avoided for safety reasons. Low speeds increase the time needed to spray a given field. This increases labor costs and ties up equipment for a longer period of time.

LOADING THE SPRAYER

Mixing

Mixing the pesticide thoroughly and carefully is one of the most important steps in good sprayer operation:

- — Incomplete mixing results in varied application rates.
- — Some chemicals can form invert emulsions if mixed improperly. An invert emulsion is a thick, mayonnaise-like mixture that will not spray properly and is very difficult to clean out of a sprayer.

— The operator is most likely to be exposed to dangerous amounts of pesticide during mixing because he is handling the material in concentrated form. Pesticides can be mixed in the tank or in a premix container. Specific instructions are given on the label of each pesticide. Follow them carefully. Adding chemicals in the wrong sequence can prevent otherwise compatible materials from mixing properly.

To mix some chemicals in the tank, add the pesticide to one-half tank of water. Turn on the agitator and mix thoroughly. Then finish filling the tank with water. For other materials, agitation must be started before adding pesticide and continued until all chemical/water mix has been used.

If a premix container is used, fill it about one-half full of water then add pesticide. Stir the mixture until it is smooth and uniform, then add it to the water in the sprayer tank. Premixing an emulsifiable concentrate with water to form an emulsion, or premixing a wettable powder with water to form a slurry, and then adding these to a partially-filled well-agitated spray tank can help reduce mixing problems with some pesticides.

WETTABLE POWDERS AND FLOWABLES

These formulations are being used by an increasing number of farmers. In some cases, the desired chemicals are only available as wettable powders because of difficulties or expense in making them into liquids. These chemicals are effective, but application takes special equipment and know-how. The newer model sprayers will generally be able to apply these formulations without problem, but older sprayers may require extensive modification.

To ensure adequate agitation to keep the pesticide in suspension, a mechanical or hydraulic agitator must be installed in the sprayer tank. The paddle type mechanical agitation is best, but jet agitators are quite satisfactory if pump output is sufficient to provide 3 to 6 litres/minute per 100 litres of tank size in addition to the requirements for applying the nozzles. Larger tanks will require two or more agitators.

Jet agitators may be equipped with various sizes of orifice discs, depending on the amount of surplus pump capacity. Naturally, the larger orifice sizes provide more agitation, but there is a limit beyond which the pump cannot supply enough pressure. To determine the best size of orifice may require trial and error, although charts are provided with the agitator so that a rough first selection can be made.

To avoid plugging, all strainers in the sprayer system must be the screen or slotted type and not finer than 50 mesh. Powders act as a fine abrasive and rapidly erode brass nozzles.

A special procedure for adding wettable powders to the tank should be followed to ensure that the powder goes into suspension, rather than forming lumps. Start by premixing the material with water in a pail. Half fill the sprayer tank with water and turn on the agitator. Slowly pour the slurry into the tank. If you are making a tank mix, add the other chemicals, then fill the tank and begin spraying. Do not leave wettable powders standing in the tank. Once they settle to the bottom it will be difficult to get them back into suspension.

Without the proper equipment and procedures, farmers should not use wettable powders as the results will be disappointing and the application a source of frustration.

NOTE: Do not confuse wettable powders with soluble powders. Soluble powders truly dissolve in water, they do not remain as a suspended solid. They do not require any special handling, other than a little time and agitation to dissolve them and they will not settle out.

FIELD OPERATION

Transport loaded sprayers as short a distance as possible. An accident could spill a load of chemicals on the road or in a ditch, where it could be very hard to contain and cleanup. If agitation of some mixtures is stopped during transport to the field it may be difficult or impossible to obtain adequate remixing.

Pesticide may drift for considerable distances: as a vapor from a volatile chemical, and as fine droplets carried by the wind. Vapor drift can be reduced by using chemicals which do not vaporize easily (amines rather than esters).

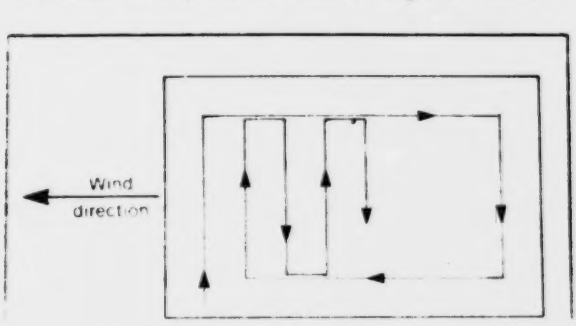
Droplet drift may be reduced by spraying during low or no-wind conditions and by the use of proper equipment. Using an accurate pressure gauge, spraying at 275 kPa or less, increasing the volume of water applied, using low-drift nozzle tips and decreasing boom height will all reduce spray drift.

End nozzle use must be limited to fence rows and ditches, and only under no-wind conditions. The spray pattern produced by end nozzles is susceptible to drift.

Misses and overlaps should be avoided. Plugged and worn nozzle tips must be cleaned or replaced. The tractor drawbar should be fixed and not have excessive movement. The boom flow should be stopped at the headlands. This prevents overlapping and misses.

Suggested method of field spraying

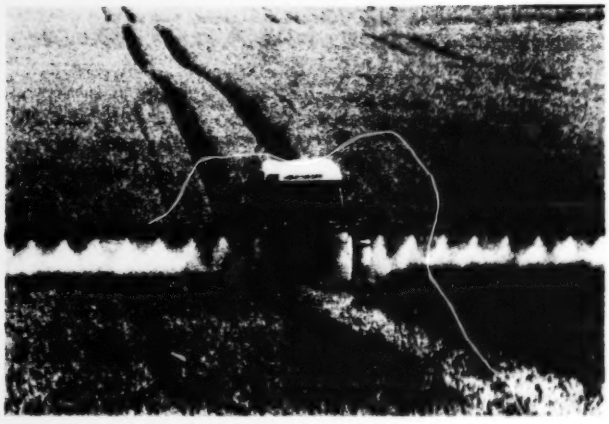
The boom flow should be stopped at the headlands. This prevents overlapping and misses.



Suggested method

FIELD MARKERS

Field markers are available to aid the operator in preventing misses and overlaps. The disc marker, flag marker, foam marker and spot dye marker and paper marker are commercially available. Operators who have used each method should be consulted prior to purchasing a marker.



Tramlines

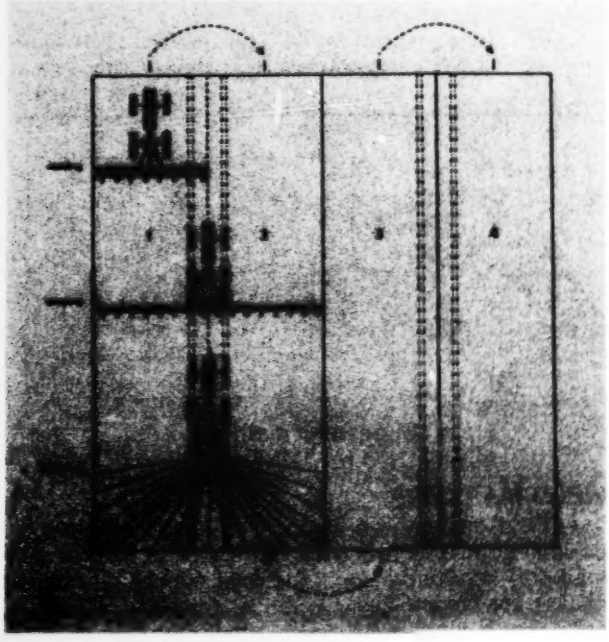
TRAMLINES

Farmers in some European countries use tramlines as a field marking system in cereal and oilseed crops.

The principle of tramlines is to match the working widths of sprayers with that of the seed drill so that spraying operations can be carried out along the tracks laid while seeding. The working width of the seed drill must first be established and then related to the width of the sprayer boom. The boom may need shortening or lengthening so that a multiple of drill passes matches one pass of the sprayer thus enabling the tramlines to be placed at appropriate intervals.

Block a single drill run which is one-half the width of the tractor track from the end of the drill.

This puts in one tramline going up the field and another coming back. This system works well if spraying equipment is twice the width or 4 times the width of the seeder.



Setting up tramlines

Other methods for producing tramlines can be used however the one described is the simplest to implement.

Indications are that any potential yield losses when using tramlines are compensated for as follows:

- rows that are adjacent to the tramline can draw on extra moisture and soil nutrients and produce more seed.
- more accurate chemical placement without double coverage or missed strips creates potential for increased yields.
- trampling from tractor wheels creates some yield loss even if tramlines are not used.

SPRAYER CLEANUP

Proper maintenance of a sprayer will result in longer life and more hours of trouble-free operation. Consult your operator's manual for proper maintenance procedures.

The sprayer should be cleaned at the end of each day of use by flushing the tank, pump and booms with clean water. Remove and clean out filters, screens and nozzle tips.

Plugged tips should be cleaned with a soft brush. Never use your mouth to blow a tip clean.

Cleaning For Storage Or When Changing Chemicals

1. Choose your cleaning area carefully, making sure that discharged cleaning water will not contaminate streams or crops, or be accessible to children and animals.
2. Dilute spray residue by filling the tank with water and circulate through sprayer.
3. Remove all strainers and nozzles and clean thoroughly.
4. Drain the spray solution from tanks, hoses, booms, pumps, and strainers.
5. Rinse the entire system thoroughly with clean water.
6. Fill the sprayer completely with water, circulating it through the entire system.
7. Drain completely.
8. Fill tank with water then add 1 litre of household ammonia per 100 litres of tank capacity.
   0.5 kgs Nutrasol, Solventol or lye, or 1 kg of trisodium phosphate per 100 litres of tank capacity may be used instead of household ammonia.
9. Circulate to ensure that solution contacts all the internal parts of the sprayer.
10. Allow the solution to remain in the tank and hoses overnight.
11. The following day, recirculate the entire system, remove end caps on the booms and then drain completely.
12. Rinse out twice with clean water, recirculating and draining each time.

At Seasons End

1. Add light oil or antifreeze during the final stage of last rinsing to leave a protective coating on all internal parts.
2. Remove pump and store indoors.
3. Close all openings into the sprayer to prevent entry of debris or rodents.

NOTE: All pesticides have specific cleaning recommendations. Refer to product labels for specifics.

CONTAINER RINSING AND DISPOSAL

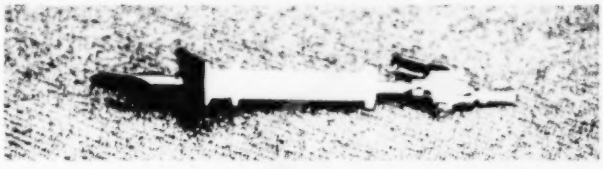
Pesticide containers should be triple-rinsed when being emptied. Studies have shown that applicators may leave up to 15 per cent of a herbicide in a container as it is emptied into the spray tank. A good idea is to instal a T connection on the outlet side of the pump and add a valve and length of garden hose to it to allow for back rinsing of farm chemical pails.

Can Rinsers

Can rinsers are designed for use in both metal cans and plastic jugs. The hose from a water source or from the nurse tank pump is securely attached to the rinser. After ensuring that the valve is on 'off' position insert the sharp piercing end of the rinser into the bottom centre of the inverted metal container or the side wall (near the bottom) of a plastic container. The water under pressure can be turned on and off at your convenience and the leftover pesticide residue is rinsed into the spray tank.

When you use a can rinser there is no need to use the Triple rinsing method of rinsing pesticide containers. A can rinser requires 30 seconds to rinse pesticide containers as compared to five minutes for triple rinsing, saving valuable time.

A rinser renders the containers useless for any future use by puncturing them, and reducing potential health and environmental hazards.



Can rinser

Disposal of empty containers must be done in a safe manner. In Alberta there are centralized sites where all types of pesticide containers are collected for recycling.

DRIFT CONTROL

Spray drift is a major problem to those applying herbicides. Drift can increase the quantity of chemical entering the air and pollutants may damage beneficial insects or harm sensitive crops and gardens.

Kinds Of Spray Drift

Herbicides may reach non-target plants, animals, or humans by wind drifting or by vapors carried in the air. The effect is the same but an understanding of both kinds of drift is required in order to affect control.

Vapor Drift — Vapor drift is the movement of herbicide in the gaseous or vapor state.

The degree to which a herbicide evaporates is determined by the temperature (increases with high temperature) and by the chemical formulation itself. Where possible, low volatile formulations or non-volatile herbicides should be used. With most spraying, the effects of vapor drift will not be seen immediately, but may show up in unrelated areas and it will often be a puzzle as to how the contamination occurred.

Droplet Drift — Droplet drift refers to the wind borne movement of spray particles of very small size. The production of very small particles is a function of the spraying operation, rather than the herbicide itself. The extent of damage depends upon the wind direction, the amount of fine spray droplets, and the susceptibility of the plant or animal which the droplets contact.

Droplet size depends on:

1. nozzle design
2. nozzle size and
3. spraying pressure.

Lower pressure produces larger droplets, while higher pressure tends to produce smaller droplets. High volume nozzles produce larger spray droplets than low volume nozzles.

The height above target is important because it affects the time required for the spray droplets to reach the target, and as a result, the time the droplets can be affected by the wind.

The height at which the nozzles must operate is fixed by nozzle spacing and nozzle design. It is not possible to lower the spray boom below this proper height unless different nozzles are installed.

Using Nozzles To Control Drift

Flat Fan Nozzles — The most common nozzles in use produce a spray pattern of 80°. This feature requires the spray boom to be set at least 40 cm above the target being sprayed to give proper overlapping of spray patterns. Spraying from this height allows wind to affect the spray, causing drift if the droplets are too small.

Nozzles that produce a wide spray pattern enable the spray boom to be set closer to the target, thereby reducing spray drift.

Low Pressure Nozzles — Low pressure nozzles are flat fan nozzles which are specifically designed to operate at low pressures to produce larger droplets. They produce the same spray angle, and liquid distribution at 100 kPa as the standard nozzle at 275 kPa. They can also be used at higher pressure, however, smaller droplets and a wider spray angle will be produced if pressures are increased beyond 100 kPa.

Flooding Fan Nozzles — Flooding fan nozzles have been in use for applying liquid fertilizer. They may be recommended for the application of certain herbicides. Flooding fan nozzles can be used in winds up to 20 km/h with reasonable safety. This is partly due to the larger spray droplets produced by this type of nozzle. The wide angle of spray pattern formed allows the spray boom to be set about 30 cm above the target, thereby reducing the wind effect.

It is essential that the sprayer be equipped with boom wheels to keep the boom ends from contacting the ground.

CAUTION: It is generally accepted that under calm conditions, the uniformity of the pattern produced by flooding fan nozzles is inferior to the pattern produced by regular flat fan nozzles. Flooding nozzles should not be used unless specifically recommended by the herbicide manufacturer.

Raindrop Nozzles — Raindrop nozzles can produce a spray pattern with an angle of 80-100 degrees, depending upon nozzle size and operating pressure. They must be set at 60° to 90° to the vertical in order to obtain a reasonably uniform pattern. They produce larger droplets than the conventional flat fan nozzles. The larger droplets can enable spraying when the wind is too strong for conventional nozzles.

CAUTION: Raindrop nozzles should not be used unless specifically recommended by the herbicide manufacturer.

Angle-Height of Boom — When herbicides are applied for wild oat control, it is recommended that the spray be directed forward at a 45° angle. When the boom is turned to direct the spray forward, it must also be lowered in order to maintain the correct overlapping spray pattern. This form of adjustment may be used for all herbicide applications as similar coverage is obtained, and since the boom is closer to the ground, chemical drift is reduced. The distance the spray droplets must travel is the same, regardless of whether the boom is turned 45° and lowered or left higher and turned vertically. The difference is that wind velocity is always lower nearer the ground.

Using Foams For Drift Control

Special techniques have been developed to help overcome the problem of spray drift. Some of these techniques include the use of additives that are designed to change the chemical solution to a foam-like substance when added to the spray tank. However, in order to make use of some of these additives, major changes to the sprayer may be required.

CAUTION: These additives may alter the activity of some herbicides, especially where thorough coverage is required. Do not use unless recommended for use with the herbicide.

(a) Invert Emulsions — Invert emulsions are formed when a small amount of water is mixed into a chemical/oil solution. A thick, mayonnaise-like emulsion forms at the nozzle. This emulsion is sprayed out of special nozzles. The sprayer would also require some expensive alterations.

(b) Thickening Agents — A thickening agent is added to the spray mix in the tank and produces a jelly-like spray solution. A centrifugal or piston pump is required for effective use.

(c) Particulating Agents — A particulating agent is injected into the spray mix in the tank and produces large particles containing the herbicide at the nozzle. No special equipment, other than the injector, is required. However, considerable care is required to apply this spray because temperature and acidity of the water will affect the proper formation of the large particles at the nozzle.

A product commonly used for drift control in industrial spraying operations is NALCO-TROL. It is not recommended for on-farm use.

IMPORTANT: Never add water to the NALCO-TROL container.

Shake NALCO-TROL container well. Always add wettable powder herbicides **before** NALCO-TROL and assure dispersion prior to NALCO-TROL addition. For liquid herbicides NALCO-TROL should be added **first** and mixed for 10 minutes prior to the herbicide addition. The measured amount of NALCO-TROL should be added as a pencil-thin stream to the agitating tank mix or for tanks with weak agitation to the surface agitation created during the tank filling operation.

Continue to agitate mix tank for at least 5 minutes before use.

Application Uniformity Versus Drift

The objective of pesticide spraying is to control a problem (weed, insect, fungus). Choosing the correct chemical is half of the solution; applying that chemical uniformly at the desired rate is the other half.

Selecting the correct chemicals is not a problem when using the guidelines and information published by the chemical companies, the various government and university agencies.

However, a problem does exist when attempting to apply the chemical uniformly and without drift. Even with today's technology this is impossible. We must therefore compromise between uniformity and some drift.

The following table illustrates that the 8002 and 8002LP tips produce the most uniform pattern and the least drift. Since the 8002LP (at 100 kPa) may not be suitable for some herbicide applications the 8002 tip would be a good choice.

By increasing the volume of water applied the drift is substantially reduced (compare 650067 and 65015). Combining the effects of increased water volume with the supe-

Nozzle Tip Drift Comparison

Spray Rig	Nozzle Tip	Pressure kPa	cv (%)*	Target Deposit Average Droplet Size (um)**	Relative Drift*** (20 km/h wind)
Ground	650067	275	27	390	7
Ground	65015	275	23	550	3.5
Ground	8002	210	19	650	2
Ground	8002LP	100	21	860	1
Ground	TK.75	275	28	390	3
Spray Coupe	730077	275	28	250	19
Pawnee***	D4-45	170	35	200	25 at 10 km/h
Agwagon****	D4-45	170	46	200	49 at 10 km/h
Pawnee****	D10-45	170	42	300	14 at 10 km/h
Agwagon ****	D10-45	170	46	220	43 at 10 km/h

* The cv (coefficient of variation) is a measure of pattern uniformity. The lower the cv, the better the pattern uniformity. A cv of 20 - 25% may be acceptable but a cv below 20% is desirable.

** Average droplet size implies that 50% of the droplets are larger than this figure and 50% are smaller. (1000 um = 1 mm).

*** Relative drift is the drift of a tip in relation to the tip with the least drift (i.e. 1). For example, the 650067 tip has 7 times the drift of the 8002LP. The drift was measured 5 metres downwind from the edge of the swath.

**** Aircraft.

rior performance of the 80 tips the best compromise of uniform deposits and reduced drift is achieved.

The TK.75 tip, commonly used with wild oat chemicals, has poor uniformity and medium drift control characteristics. These factors limit flooding tip use to only those chemicals which specify them.

The table also provides a comparison of other application methods in use, i.e. the "Spray Coupe" and aircraft.

TROUBLESHOOTING

Sprayers fail to operate correctly because of breakage, corrosion, abrasion or pumps that run dry. Avoid breakage by selecting good equipment, operating carefully, and maintaining properly.

Here are some of the more common problems that can occur with sprayers. Possible causes and remedies are included.

Problem	Possible Cause	Remedy
Loss of pressure	1. Pressure regulator improperly adjusted or stuck open.	1. Clean and adjust pressure regulator.
	2. Suction screen plugged.	2. Thoroughly clean screen.
	3. Cracked or porous suction hose.	3. Replace hose.
	4. Worn pump.	4. Replace or recondition pump according to the manufacturer's instructions.
	5. Worn nozzle tips.	5. Replace nozzle tips.
	6. Faulty gauge.	6. Replace gauge.
	7. Pump starving.	7. Check for collapsed suction hose, plugged filter, main control valve too small or wrong type.
Excessive pressure	1. Pressure regulator improperly set or stuck.	1. Adjust pressure regulator.
	2. Bypass hose plugged or too small.	2. Unplug the hose or replace it with a larger one.
	3. Faulty gauge.	3. Replace gauge.
Pressure gauge needle jumps excessively.	1. Gauge too sensitive.	1. Replace gauge or mount a flow regulator between the gauge and the pump.
	2. Pump starving.	2. Check for restriction on inlet side of pump.
Nozzles plugging	1. Too fine a nozzle screen or the screen is corroded.	1. Replace with the proper mesh screen or clean the screen thoroughly.
	2. Dirty water or foreign material in the tank.	2. Drain tank and clean thoroughly; check suction screen for holes.
	3. Chemical (wettable powder) not properly mixed.	3. Increase agitation.
	4. Nozzles too small.	4. Replace with the proper nozzles for the chemical being used.
	5. Boom filled with foreign material.	5. Remove the plugs in the ends of the boom section to clean the boom.
Poor spray patterns	1. Booms too low.	1. Raise boom, or rotate ahead or back slightly.
	2. Pressure too low.	2. Check pressure on boom end with a gauge. Presure should be within 10 to 15 kPa of main gauge. If not, check sizes of fittings and hoses for restrictions.
	3. Nozzles worn or damaged.	3. Replace nozzles.
Uneven spray pattern from nozzle.	1. Nozzle screen plugged.	1. Clean or replace screen.
	2. Nozzle tip damaged.	2. Replace tip with new one.
Visible spray drift	1. Spray too fine.	1. Cut pressure down, use larger nozzles.
	2. Boom set too high.	2. Lower boom and angle forward or back.
	3. Too windy.	3. Quit spraying.
Booms swinging	1. Loose hitch between sprayer and tractor.	1. Tighten hitch or use ball type hitch.
	2. No braces.	2. Install horizontal braces on boom.
Booms moving up and down	1. No boom wheels.	1. Install boom wheels.
	2. Rough field.	2. Slow down.

WARNING: The tank filler hose should be supplied with an automatic shut off and check valve to prevent the tank solution from siphoning into the water supply when the pump has been shut off. If siphoning should occur, the water supply would be unfit for ANY use.

GRANULAR APPLICATION

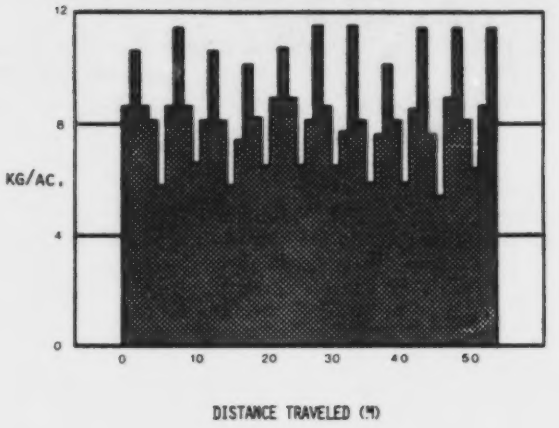
APPLICATION AND CALIBRATION

Granular herbicides, not unlike liquids, are required to be applied accurately and uniformly on the entire field. Granular herbicides do not diffuse more than ⅓ inch in the soil. If they are not applied uniformly this can lead to areas of no control and other areas where the crop is injured.

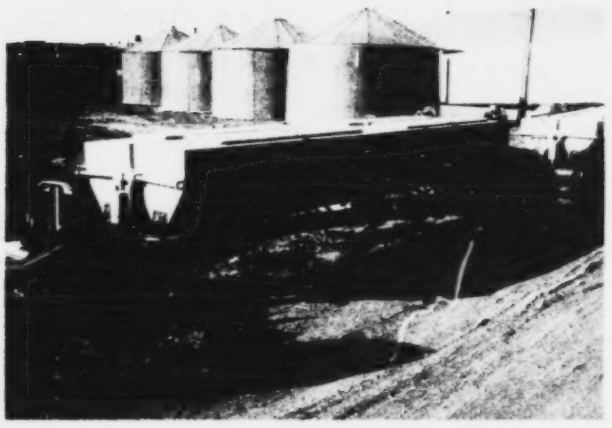
The rate of application is critical to the extent that an underapplication of 20 per cent can lead to only 50 per cent control. Also an overapplication by 20 per cent can become fairly expensive not only in dollars paid for the herbicide, but because overapplication causes residues to persist into the following year causing crop injury.

A wide variety of granular applicators is available on the market today. Gravity and pneumatic applicators in implement-mount, skid-mount and pull-type trailer models are common. Some can be mounted on tillage equipment up to 70 feet wide. Some have electronic monitoring devices and some are available with automatic electronic rate controllers. Pneumatic applicators seem to be taking over from the gravity type machines, especially the implement-mounted type for wide, multi-winged, tillage equipment. Rental agencies and custom applicators utilize trailer-type and skid-mount pneumatic applicators almost exclusively.

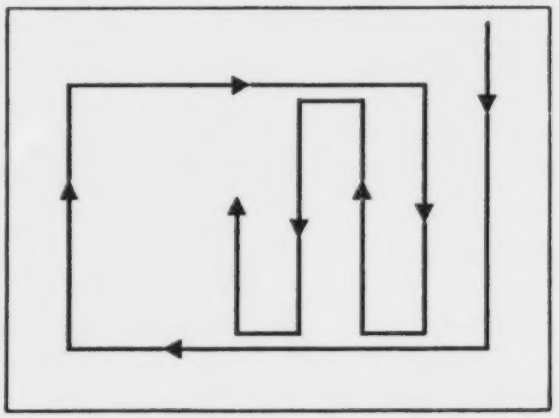
Typical distribution of Avadex BW granules below one discharge opening in the direction of travel.



Application uniformity



Pull type gravity applicator



Suggested method for herbicide application

According to testing done by PAMI the pneumatic applicators provide a fairly uniform and accurate distribution of granular herbicides provided they are assembled, calibrated and operated correctly.

Some gravity type machines tested did not provide a very uniform distribution of granules, particularly on rough or hilly fields. Also, surging in application rates in the direction of travel occurred with some gravity type applicators. The surging in application rate occurred because of the feed screw moving across the opening in the metering mechanism.

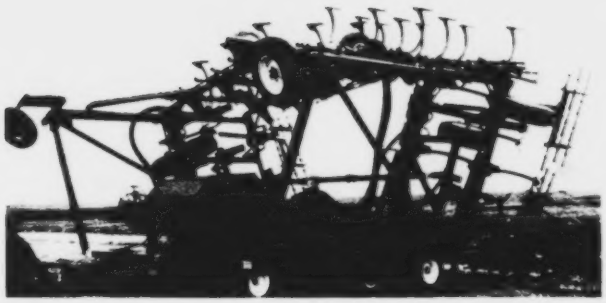
To prevent herbicide residue buildup and crop injury, the following diagram is provided as a suggested method to use when applying herbicides.

Make one or two passes around the perimeter of the field, then travel up and down the field shutting off the herbicide applicator while turning around in the field perimeter.

Regardless of which type of granular applicator is used there are some constant "Do's and Don'ts" to keep in mind to achieve as uniform an application as possible. Keep in mind that even the most thorough incorporationg job will not improve a poor job of applying the herbicide.

It is generally agreed that the most efficient method of applying granular herbicide is with an applicator mounted on a tillage implement. It saves money by providing application and incorporation in one trip over the field and it also provides an accurate marker system to avoid doubling over a treated area.

A marker system is important in any herbicide application, but it can be critical when applying residual granular herbicides that are commonly used. For example a two foot overlap using a 40 foot machine will cause 5 per cent of a field to be covered twice. If a product costs $13 per acre at the recommended rate, a waste of 65 cents per acre oc-



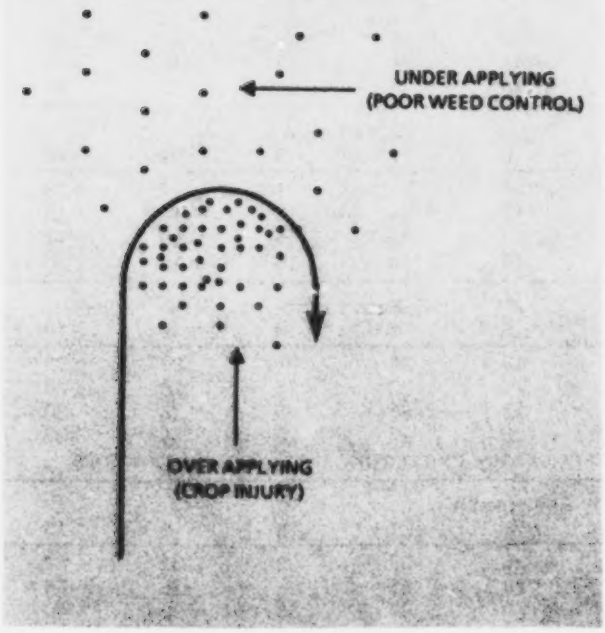
Pneumatic applicator — implement mounted

curs. Add to this the yield reduction in the current year plus damage to the crop the following year because of residue carry over.

Trailer-type and skid-mounted applicators have marking systems available as options. Markers include foam types, paint markers and disc markers, however, many rental units do not have any marker system.

All herbicide applicators must be shut off while turning to prevent erratic application on field perimeters. If the applicator is not shut off on turns the area on the inside of the turn will receive a heavy dose of herbicide because that portion of the applicator will be almost standing still. The area being covered by the outside portion of the applicator will receive much less herbicide than is required. This will result in some areas of crop damage and other areas of no weed control.

Typical uneven distribution obtained when applicator is not shut off when cornering.



Typical uneven distribution

A continuous check on the calibration of all granular applicators is necessary because flowability of granules changes with temperature and humidity. High temperature and or humidity cause granules to become sticky and not flow uniformly. Granular herbicides should be stored in a cool and dry place out of the sunlight. They should never be left in the hopper overnight as moisture can cause the granules to form a crust and plug the metering devices. Leftover chemical should always be removed from the entire system. Granular herbicides should be screened to separate out lumpy herbicide which would affect metering. The lid on hopper boxes must be kept closed to prevent moisture or debris from entering.

The following checklist summarizes the maintenance activities necessary to obtain the best results and durability from airflow granular applicators:

1. Inspect and clean — hopper bottom, feed metering rollers, venturies and hoses should be checked at least once daily to ensure that they are free of moisture, dust, chaff, stones, etc.
2. Airflow hoses — check daily for wear. Turn hoses 90° yearly, to extend life.
3. Lubricate — grease all moving parts frequently.
4. Electric clutch metering drive feed metering system — check daily for proper operation. Ensure that all components of the metering assembly are tight and in line.
5. Fan Inlet — ensure that it is free and clear of all obstructions.
6. Fan Belt — check for wear.
7. Ground drive only — check tire pressure as it can affect rate of application.
8. Fan Drives —
   (a) Auxiliary gas engines — check oil and air filter daily. Ensure fan speed of 3,000 to 3,600 rpm.
   (b) PTO Drive (NODET*) — operate with 540 or 1,000** rpm PTO, (**1,000 rpm PTO requires adapter kit), to produce a fan speed of 3,600 to 4,000 rpm.
   (c) Hydraulic Motor —

Applicator Model	Tractor Hydraulic Flow	Fan Speed
Beline COMPUTAIRE*	10 gpm	2,900 rpm
Gandy AIR-SPEED*	8 gpm	4,000 rpm
Valmar AIRFLOW*	10 - 12 gpm	3,000 - 3,600 rpm

9. Wet Equipment — after heavy dew or rain clean hopper bottom and feed metering rollers and run fan about 15 minutes to dry out hoses and venturi system.
10. Outlet uniformity — before loading hopper, inspect for obstruction in the airflow system by checking air velocity at all outlets.
11. Marking system — for trailer type or truck mounted applicators, especially in stubble conditions, a sturdy disc-type marker or a properly operating foam marker is necessary for accurate application.
12. Hopper screen — be sure to load product through the hopper screen to prevent foreign material (paper, dirt, straw, etc.) from entering and plugging or damaging the metering system.
13. Application delays — to prevent moisture absorption and caking, avoid letting product remain in the applicator overnight or for other prolonged periods of time, especially during high temperatures and excessive moisture.

14. Calibrate — frequent calibration is necessary to ensure accurate and consistent rates of application. Rate charts and calibration instructions are available from the applicator manufacturer.

Calibration

Correct calibration of granular applicators is essential for accurate herbicide application. The operator's manual for each granular applicator contains information on procedures to follow for correct calibration settings and how to check the calibration. When renting an applicator ensure that an operator's manual is made available. It is critical that granular applicators are calibrated for the particular granule size to be applied. When renting a unit this is extremely important as the previous renter may have calibrated it for some other product.

1. Fill the hopper(s) to a pre-determined level.
2. Treat an area of known dimension.
3. Weigh a full bag.
4. Refill the hopper(s) from the bag to the original level in the applicator.
5. Weigh the remainder left in the bag.
6. Calculate the amount used by subtracting the weight of the remainder from the weight of the full bag.
7. Divide this by the area treated to determine the rate per acre.
8. Adjust the gauge setting if necessary.

Preparing For Storage

— vacuum or blow out the applicator.
— cover with tarp, don't store in direct sunlight.
— remove chains, metering devices and control boxes and store indoors.
— cover electric clutches with a plastic bag.

EQUIPMENT SETTINGS FOR RIVAL 10G

The following equipment guidelines should only be used as starting points for equipment calibration. All applicators should be calibrated each time they are used in order to avoid costly misapplications.

Applicator	Broadcast Rate kg/acre	Applicator	
		Sprocket on Meter Fee Screw	Sprocket on Counter Shaft
Barber Spreader Use chemical screw (and 18 tooth 2050 chain sprocket) on counter shaft (small feed screw)	3.4	14	6
	4.4	10	6
	5.6	10	8
	6.8	10	10
Beline CC-5 Computer Control	3.4	9.2	
	4.4	11.8	
	5.6	15.0	
	6.8	18.2	

		Speed km/h					
		5	6	7	8	9	10
Gandy Broadcast (Drip) Applicator S902 13 cm Spacing	3.4	8	8	9	10	10	11
	4.4	9	9	10	11	11	12
	5.6	10	11	11	12	13	14
	6.8	11	12	13	14	15	15

		Speed km/h					
		5	6	7	8	9	10
Gandy Broadcast (Drip) Applicator S902 18 cm Spacing	3.4	9	10	11	11	12	13
	4.4	10	11	12	13	14	15
	5.6	11	13	14	15	16	17
	6.8	13	14	15	16	17	18

		Speed km/h					
		5	6	7	8	9	10
Gandy Air-Sped 61 cm	3.4	16	18	20	21	22	23
	4.4	19	21	22	23	25	26
	5.6	21	23	25	26	28	30
	6.8	23	25	27	29	31	32

Above settings are recommended for each broadcast rate.

		Speed km/h					
		5	6	7	8	9	10
Gandy Air-Sped 69 cm Spacing	3.4	23	26	27	29	31	32
	4.4	26	29	31	33	35	36
	5.6	30	32	34	36	38	40
	6.8	32	35	37	39	41	43

The above settings are recommended for each broadcast rate.

		Speed km/h					
Gandy Air-Spred 76 cm Spacing		5	6	7	8	9	10
	3.4	24	27	29	31	32	34
	4.4	28	30	32	34	36	37
	5.6	31	34	36	38	40	41
	6.8	34	36	39	41	43	45
		The above settings are recommended for each broadcast rate.					

		Nodet Settings
Nodet Gougis Model MT 12	3.4	A1 - B4 - C6 - D5
	4.4	A2 - B3 - C5 - D6
	5.6	A2 - B3 - C7 - D5
	6.8	A3 - B2 - C5 - D6

		Drive Gear Ratio	Valmar Setting
Valmar Airflow Truck Mount (240) Trailer Mount (240) Implement Mount (240,320)	3.4	Low	B3
	4.4	Low	B4
	5.6	Medium	B2
	6.8	Medium	B3
		Low Gear Ratio: Use combination sprocket with 15 tooth gear on drive side and 30 tooth gear on driven side. Medium Gear Ratio: Use combination sprocket with 30 tooth gear on both drive and driven sides.	

EQUIPMENT SETTINGS FOR TREFLAN Q.R. 5

These are guidelines to be used as starting points for equipment calibration only.

		Kilograms Per Acre		
		9	11	14
Applicator	**Speed km/h**	**Meter Setting**	**Meter Setting**	**Meter Setting**
Beline Linear Control (calibrate each hopper)	6.4	40	50	60
	7.2	45	56	68
	8.0	50	62	75
	8.8	55	69	83
	9.6	60	75	90
	10.4	65	81	98
	11.2	70	88	105
Gandy Boxes (calibrate each hopper)		**Gauge Setting**	**Gauge Setting**	**Gauge Setting**
	6.4	10	10.9	12
	8.0	11	12	13
	9.6	11.5	13	14
	11.2	12.5	14	15.5
Gandy Air-Spred 61 cm spacing	6.4	21	23	25
	8.0	23	26	28
	9.6	26	28	31
	11.2	27	30	34
Gandy Air-Spred 68 cm spacing	6.4	22	25	27
	8.0	25	27	30
	9.6	27	30	33
	11.2	29	32	35
Gandy Air-Spred 76 cm spacing	6.4	23	26	28
	8.0	26	29	31
	9.6	28	31	35
	11.2	30	35	—

Granular Applicator Settings For Treflan Q.R.5

Valmar Airflow

Application Rate	Ratio	Range	Gear
9 kg/acre	Medium	B	2
11 kg/acre	Medium	B	3
14 kg/acre	Medium	B	4

Nodet 40

Application Rate	Sprocket Setting			
	A	B	C	D
9 kg/acre	2	3	5	7
11 kg/acre	2	3	7	5
14 kg/acre	2	3	6	5

EQUIPMENT SETTINGS FOR HERITAGE

These guidelines to be used as starting points for calibration only.

BELINE LINEAR III

Calibrate Each Hopper

Speed (km/h)	6.4			7.2			8.0			8.8		
kg/acre	6.5	7.6	9	6.5	7.6	9	6.5	7.6	9	6.5	7.6	9
Meter Setting	27	32	36	31	37	41	34	40	45	38	44	50
Speed (km/h)	9.6			10.4			11.2					
kg/acre	6.5	7.6	9	6.5	7.6	9	6.5	7.6	9			
Meter Setting	41	48	55	44	52	59	48	56	64			

GANDY BOXES

Calibrate Each Hopper

Speed (km/h)	6.4			8.0			9.6			11.2		
kg/acre	6.5	7.6	9	6.5	7.6	9	6.5	7.6	9	6.5	7.6	9
Gauge Setting	8	8.5	9	8.5	9.3	10	9.5	10	10.5	10	10.7	11.5

GANDY AIR SPRED

	6 km/h			8.0 km/h			9.6 km/h		
kg/acre	6.5	7.6	9	6.5	7.6	9	6.5	7.6	9
(61 cm Spacing) Gauge Setting	15	16	17	17	18	19	18	20	21
(68 cm Spacing) Gauge Setting	16	17	18	17	19	20	19	21	22
(76 cm Spacing) Gauge Setting	16	18	19	18	20	21	20	22	23

VALMAR AIRFLOW

Kilograms Per Acre	Ratio	Range	Gear
4.5	Low	B	2
6.5	Low	A	3
7.6	Low	B	4
9.0	Low	B	5

At high temperatures the product HERITAGE* may stick to the feed rollers causing a 10-18 per cent decline in application rate.

NODET 40

Kilograms Per Acre	Sprocket Setting A	B	C	D	Actual Amount Applied
4.5	1	4	5	7	4.8 kg ac
6.5	1	4	5	7	6.9 kg ac
7.6	1	4	7	5	7.9 kg ac
9.0	1	4	6	5	9.0 kg ac

*Remove #3 and #4 gears from hidden gear box and replace with #2 gear on top and #8 gear on bottom.

EQUIPMENT SETTINGS FOR AVADEX BW

Guide Settings For Gandy Air-Sped Granular Applicators To Apply Avadex BW

Gauge Setting	kg/acre (61 cm Spacing) 6.4 km/h	8.0 km/h	9.6 km/h	11.2 km/h	12.8 km/h	14.4 km/h	16 km/h
25	5.3						
26	5.8						
27	6.3	5.1					
28	6.8	5.5					
29	7.4	5.9					
30	7.9	6.3	5.3				
31		6.8	5.7				
32		7.4	6.2	5.3			
33		7.9	6.6	5.6			
34			7.0	6.1	5.3		
35			7.5	6.5	5.6		
36			8.0	6.8	6.0	5.3	
37				7.3	6.3	5.6	
38				7.6	6.7	6.0	5.3
39				8.0	7.0	6.3	5.6
40					7.4	6.5	6.0
45					9.9	8.8	7.9

Guide Settings For Gandy Air-Spred Granular Applicators To Apply Avadex BW

Gauge Setting	Kilograms Per Acre @ 68 cm Spacing 6.4 km/h	8.0 km/h	9.6 km/h	11.2 km/h	12.8 km/h	14.4 km/h	16 km/h
25	—						
26	5.2						
27	5.7						
28	6.1						
29	6.5	5.2					
30	7.0	5.6					
31	7.6	6.1	5.1				
32	8.2	6.6	5.5				
33		7.1	5.9				
34		7.5	6.3	5.4			
35		8.0	6.7	5.7			
36			7.1	6.1	5.3		
37			7.5	6.4	5.6		
38			7.9	6.8	5.9	5.2	
39				7.1	6.2	5.5	
40				7.5	6.5	5.8	5.2
45				10.0	8.8	7.8	7.0
50							8.9

Guide Settings For Gandy Air-Spred Granular Applicators To Apply Avadex BW

Gauge Setting	Kilograms Per Acre @ 76 cm Spacing						
	6.4 km/h	8.0 km/h	9.6 km/h	11.2 km/h	12.8 km/h	14.4 km/h	16 km/h
27	5.1						
28	5.5						
29	5.9						
30	6.3	5.0					
31	6.8	5.5					
32	7.4	5.9					
33	7.9	6.3	5.3				
34		6.8	5.7				
35		7.2	6.0	5.2			
36		7.7	6.4	5.5			
37		8.1	6.8	5.8			
38			7.1	6.1	5.3		
39			7.5	6.4	5.6	5.0	
40			7.8	6.7	5.9	5.2	4.7
45				9.1	7.9	7.1	5.7
50						8.9	8.0

Guide Settings For Beline Granular Applicators To Apply Avadex BW

Kilograms Per Acre — Speed km/h							Meter Set Point
6.4	7.2	8.0	8.9	9.6	10.5	11.2	
4.0							36
4.5	4.0						40
5.0	4.5	4.0					45
5.6	4.9	4.5	4.0				49
6.0	5.4	4.8	4.4	4.0			54
7.0	5.8	5.3	4.8	4.4	4.0		58
7.6	6.3	5.7	5.1	4.7	4.4	4.0	63
8.0	6.8	6.1	5.5	5.1	4.7	4.3	67
8.6	7.2	6.5	5.9	5.4	5.0	4.6	71
8.9	7.6	6.9	6.3	5.7	5.3	4.9	76
	8.1	7.3	6.6	6.1	5.6	5.2	80
	8.5	7.7	7.0	6.4	5.9	5.5	85
	9.0	8.1	7.4	6.8	6.2	5.8	89
		8.5	7.7	7.1	6.5	6.1	94
		8.9	8.1	7.4	6.8	6.4	98

Guide Settings For Valmar Granular Applicators To Apply Avadex BW

Kilograms Per Acre — Gear Box Setting										Drive Gear Ratio
No.1		No.2		No.3		No.4		No.5		
B	A	B	A	B	A	B	A	B	A	
1.9	2.0	2.3	2.5	2.8	3.1	3.4	3.8	4.2		Low Ratio - Use combination sprocket with 15 tooth gear on drive and 30 tooth gear on driven side.
3.7	4.1	4.6	5.1	5.6	6.3	6.9	7.7	8.4		Medium Ratio - Use combination sprocket with 30 tooth gear on drive and 30 tooth gear on driven side.
7.5	8.2	9.2	10	11.3	12.5	13.8	15.5	16.9		High Ratio - Use combination sprocket with 30 tooth gear on drive and 15 tooth gear on driven side.

Guide Settings For Nodet Granular Applicators To Apply Avadex BW

Sprocket Settings				Kilograms Per Acre
A	B	C	D	
2	3	5	6	4.3
2	3	5	7	4.9
2	3	7	5	5.7
2	3	6	5	6.3
3	2	5	6	7.3
3	2	5	7	8.3
3	2	7	5	9.5
3	2	6	5	10.8

SOIL INCORPORATION

Soil applied herbicides have varying requirements as to depth of incorporation. The crop being grown, the weeds to be controlled, and the herbicide being used dictate just how deep the incorporation must be to achieve maximum weed control with minimum crop damage. For example, trifluralin is incorporated to a depth of 10 cm to control wild oats in a canola crop but is only incorporated to a depth of 4 cm when used to control green foxtail in cereals. If the trifluralin were incorporated deeper than 4 cm in the case of cereals the crop would be severely damaged and the herbicide concentration would be diluted in the soil profile providing poor green foxtail control.

For the above reasons it is especially important that any granular herbicide which calls for a shallow incorporation should not be applied to lumpy soil as the granules may drop between the lumps deeper than required, whereas a liquid spray is attached to the soil particles. If granules are to be used on this type of soil it will be necessary to prework the soil and bring it into the necessary condition, free of large lumps, before applying the herbicide. If this soil condition requires several operations to achieve the proper soil condition for good incorporation of the granular herbicide, it can lead to drying out the soil, as well as create a situation where the soil would be subject to wind and water erosion. Therefore, if the recommended incorporation procedure increases the erosion potential, an alternate herbicide or weed control method should be considered.

High levels of crop residue or plant growth on the soil surface affect the activity of soil-incorporated liquid herbicides because of the herbicide being absorbed by the trash. A general recommendation is to reduce crop residue and plant growth in stubble fields so that two-thirds of the soil surface is visible before applying a liquid soil incorporated herbicide. In areas where soil drifting may be a problem, excessive cultivation to prepare the soil for a liquid herbicide should be avoided.

Granular soil-incorporated herbicides were introduced to improve herbicide performance in situations where there were large amounts of straw on the soil. Granules can be applied directly to stubble before tillage operations, providing there is not too much straw or chaff to impede uniform incorporation of the herbicide. As fewer workings of the soil leave more crop residue to prevent soil drifting, the granular herbicide is recommended over the liquid.

A wide variety of tillage equipment may be used for incorporation of granular herbicides. The choice depends on availability of equipment, the soil condition, soil erosion potential, and required depth of incorporation.

Disc type implements generally provide deeper incorporation, more soil breakdown, and more uniform mixing to the depth of tillage than most other implements. This type of implement would be used where deep incorporation is needed, and where the soil is sticky or lumpy. However, where two passes are recommended for thorough and uniform herbicide distribution, and the area is subject to soil drifting, perhaps another choice in equipment would be more suitable.

Cultivators tend to give shallower incorporation than disc implements. Cultivators with rigid shanks, wide shank spacing, and low lift sweeps can be expected to provide poor uniformity of incorporation and uneven depth, especially at slower speeds. Cultivators with flexible shanks, narrow shank spacing and high lift sweeps provide more uniform incorporation when used at high speeds of travel. However, the incorporation is shallower.

Harrows are used for shallow incorporation but soil must be loose or else incorporation will be too shallow. Tine harrows behind cultivators tend to provide more mixing than drag harrows owing to the movement of the tines. Rotary or oscillating harrows are more effective in heavier trash conditions as they do not tend to plug up.

In general, increased speed of operation will improve soil mixing and at the same time increase the risk of soil erosion.

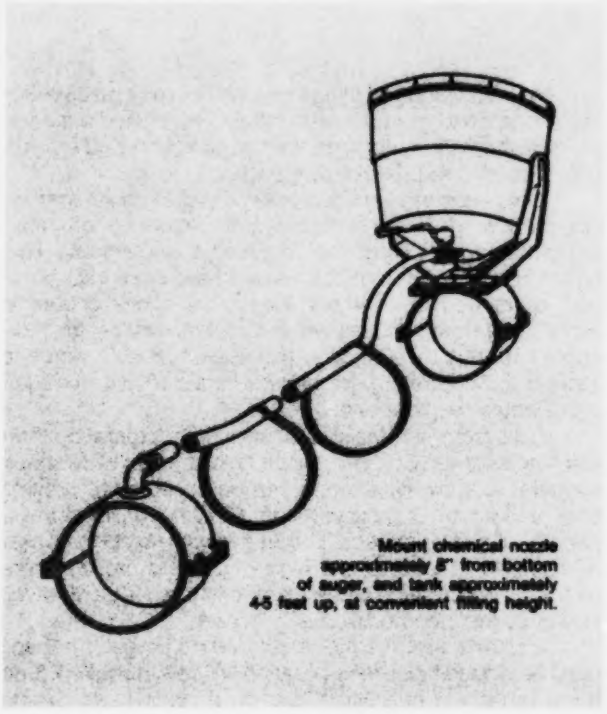
Rod weeders and other wide blade implements do not provide good incorporation of soil-applied herbicides because very little soil is disturbed and most of the granules are left on or near the surface.

Although there are many factors to consider when selecting a method for incorporating soil-applied herbicides, close attention must be paid to herbicide label recommendations concerning application and incorporation techniques. A careful check on soil conditions is needed to avoid drying out the soil and to avoid increasing the potential for soil erosion. Cultivated soil that is likely to dry out should be harrowed and packed after any tillage operation, be it spring or fall.

Reading and following label instructions will ensure best results unless conditions are extreme.

SEED TREATMENT APPLICATORS

A range of equipment is being used for applying liquid seed treatment chemicals. Simple drip type applicators are the most common methods used for liquid formulations, however they are difficult to calibrate accurately. Because drip-type applicators depend on gravity to operate the rate of flow changes when the level of liquid in the container changes thus necessitating adjustments to compensate for the changed flow rate. Temperature changes affect the viscosity of liquid chemicals causing them to flow at a slower rate when cold and a higher rate when warm thereby making it difficult to maintain a constant flow with gravity-type drip applicators.


Mount chemical nozzle
approximately 6" from bottom
of auger, and tank approximately
4-5 feet up, at convenient filling height.

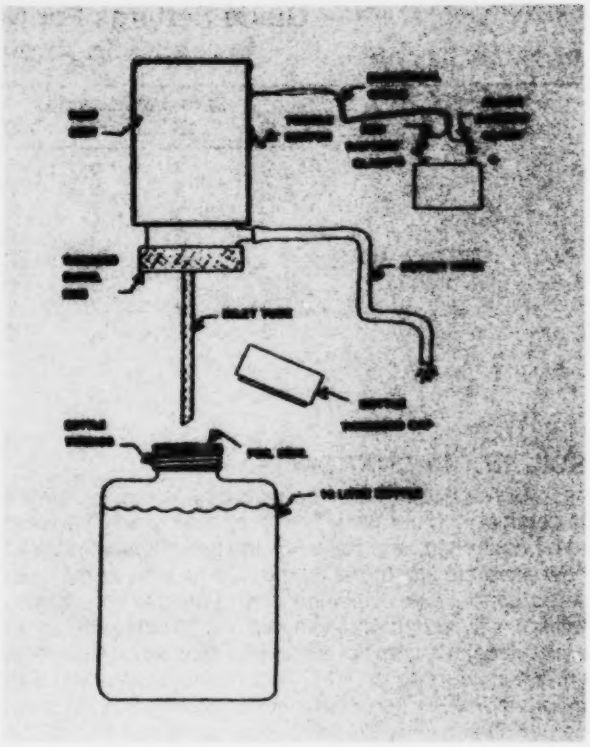
Drip applicator

Somewhat more accurate liquid seed treatment dispensers utilize an electric pump or compressed air to dispense the product onto the seed. Some units are manufactured to fit right onto the product container while others provide holding tanks for the product.

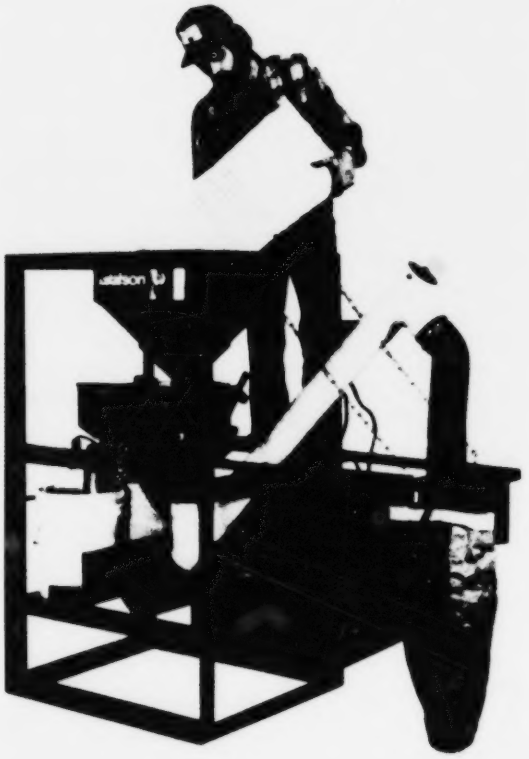
These pressurized applicators can be used in the yard while loading with an auger or mounted on the side of a truck box and used with a drill-fill.

Best results are obtained when a hopper is used at the bottom of the auger and the seed is poured into the hopper. The outlet hose is attached to the hopper so that product pours into the auger at the safety cage. Best mixing occurs when the auger is running one-half to two-thirds of capacity.

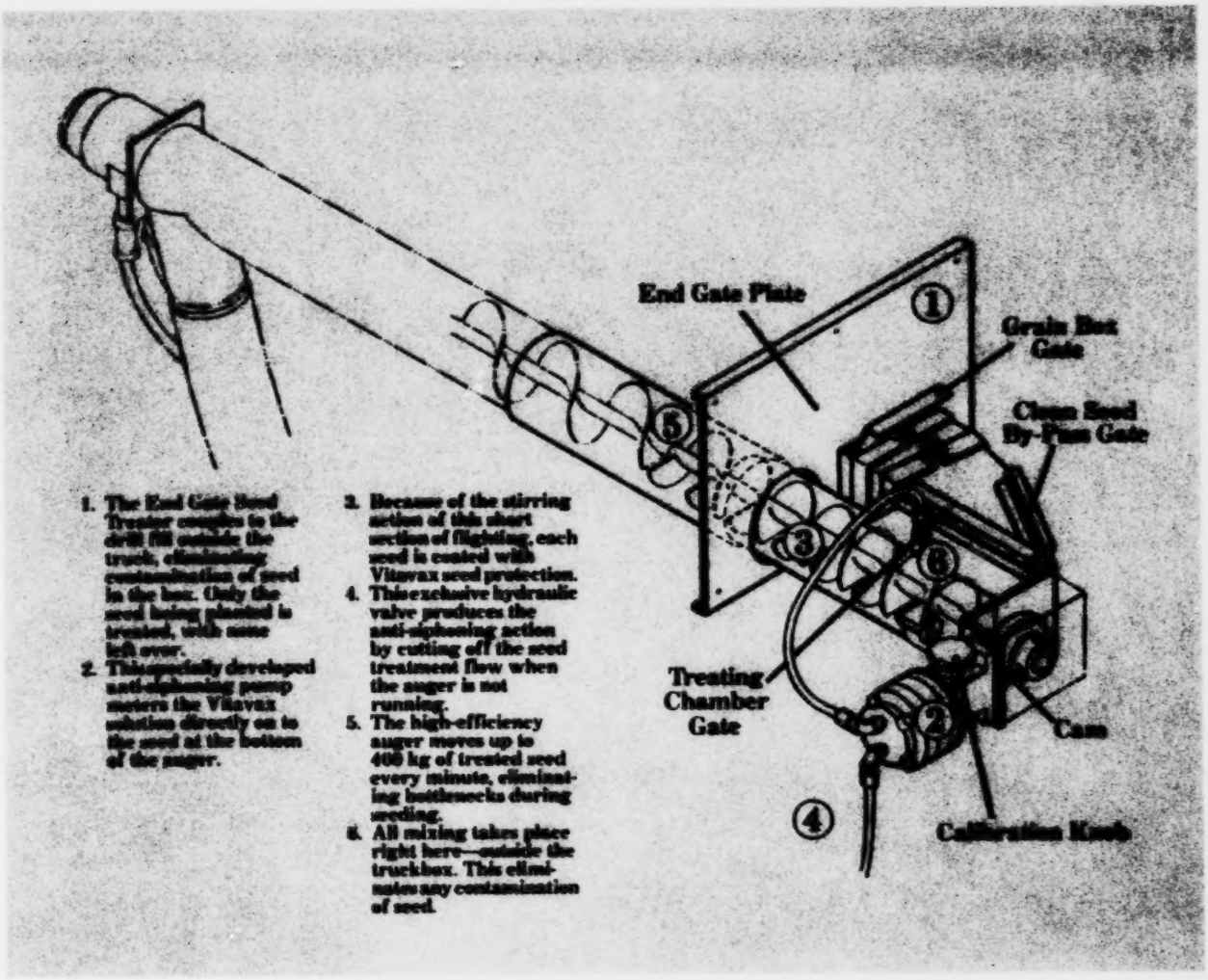
Larger capacity applicators have more versatility than smaller seed treatment product dispensers. With optional attachments it's possible to apply two or more formulations simultaneously regardless of whether they are fungicides, insecticides, flowables, slurries, powders or solutions.



Pressure applicator



On-farm seed treater


End Gate Plate
Grain Box Gate
Clean Seed By-Pass Gate
Treating Chamber Gate
Cam
Calibration Knob
1. The End Gate Seed Treater couples to the drill fill outside the truck, eliminating contamination of seed in the box. Only the seed being planted is treated, with none left over.
2. This specially developed anti-siphoning pump meters the Vitavax solution directly on to the seed at the bottom of the auger.
3. Because of the stirring action of this short section of flighting, each seed is coated with Vitavax seed protection.
4. This exclusive hydraulic valve produces the anti-siphoning action by cutting off the seed treatment flow when the auger is not running.
5. The high-efficiency auger moves up to 400 kg of treated seed every minute, eliminating bottlenecks during seeding.
6. All mixing takes place right here—outside the truckbox. This eliminates any contamination of seed.

End gate seed treater